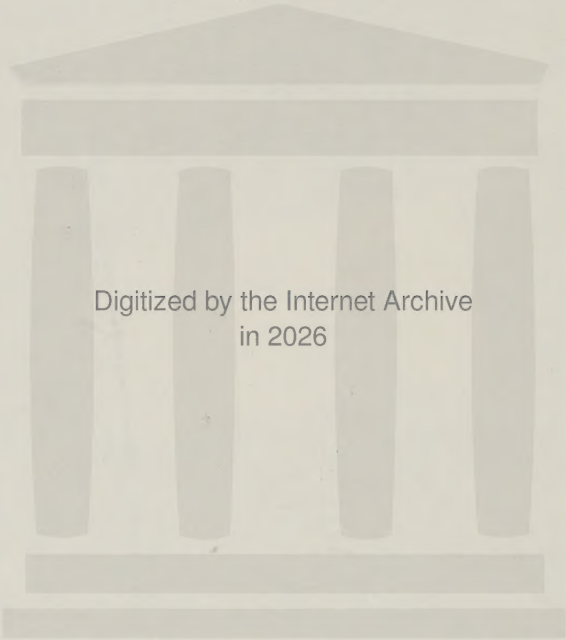


Digitized by the Internet Archive
in 2026

https://archive.org/details/offsetprintingfr0000char

STRATHCLYDE UNIVERSITY LIBRARY
30125 000906478

ANDERSONIAN LIBRARY
★
WITHDRAWN
FROM
LIBRARY
STOCK
★
UNIVERSITY OF STRATHCLYDE

ANDERSONIAN LIBRARY
22 MAY 1996
BOUND

ANDERSONIAN LIBRARY
★
WITHDRAWN
FROM
LIBRARY
STOCK
★
UNIVERSITY OF STRATHCLYDE

OFFSET PRINTING

FLOOD DAMAGE

20 JAN 1996

PRINTED AND BOUND
IN ENGLAND.

"Prospero protecting Miranda from the advances of Caliban"

Specimen of Offset Printing in five workings.

Inks by :- LORILLEUX & BOLTON, LTD.

OFFSET PRINTING

FROM STONE AND PLATES

(Planography or Metalography)

BEING A FULL CONSIDERATION OF THE NATURE AND PROPERTIES OF ZINC AND ALUMINIUM FOR PLANOGRAPHIC PRINTING BY DIRECT AND OFFSET ROTARY MACHINES: TOGETHER WITH THE PHOTOGRAPHIC METHODS OF PRODUCING THE PRINTING PLATES

By

CHARLES HARRAP

Author of "Transferring."

Instructor in Lithography and Science for Printers from 1886.

Medallist in Honours, Lithography.

Board of Education Certified Instructor in Chemistry, Electricity, Magnetism, Sound, Light, Heat, etc., etc., etc.

THIRD EDITION

(Jubilee Edition)

D
686.2325
HAR

LEICESTER:

RAITHBY, LAWRENCE & CO., LTD.

DE MONTFORT PRESS

1927

UNIVERSITY OF

0000906478

D
686.2325
H22

PREFACE TO THE FIRST EDITION.

In presenting this little treatise on Metalography to the Lithographic Printing Trade, I have arranged the matter so that it deals with the subjects of zinc and aluminium in those phases which directly interest the actual worker, and have omitted as far as possible all details of lithographic printing which are well known, or can be better treated in a work upon the whole subject. The contents of this treatise are, therefore, a section only of lithographic or planographic printing, and are complete in themselves.

I must apologise for introducing Chapter I upon lithographic stone; but it was felt that a discussion of the chemical actions which take place on stone, and are so well known to every lithographic printer, would form a good commencement for studying similar actions on the two metals. Chapters II and III upon aluminium and zinc are, therefore, very important to show the actual behaviour of these metals under similar and varying conditions to stone.

There has been no attempt to set down any one treatment in priority to others. All treatments have been chronicled, with special references to show which apparently give the more satisfactory results. But as all available methods have been dealt with, it is open to any worker to use them one by one until he finds that one with which he can produce the best results. The worker upon metals is invited to read the whole of the working details before commencing to master any one of them, because little references are scattered through these pages which are equally applicable to any method adopted. One or two makes of plates of a coated character have been left entirely undescribed, but special plates and their treatment have been grouped in Chapter XIII.

In endeavouring to simplify the treatment of metals, Chapter XVI has been introduced to give at a glance the successive treatment of either zinc or aluminium for ordinary purposes. To any printer who knows the details this tabulation serves as a guide only, and to the beginner it sketches out the operations, the details of which must be gathered from the foregoing chapters.

Chapter XV has been given as a record of known recipes, but in the general treatment of the subject sufficient references are made to show which of them are the more satisfactory. They have been placed in the order in which general experience would suggest. But as opinions and manipulation differ so much, the order there given is by no means arbitrary. The aim has been to uphold simplicity with efficiency, rather than elaborate mixtures. Every effort has been made to secure accuracy in every respect, together with simple working directions.

The proofs of this treatise have been carefully revised by numerous workers and chemical experts, amongst whom may be mentioned Messrs. J. Wilson, M.Sc., J. Crawford, and G. H. Block, to whom my thanks are due for their kindly assistance.

The proofs of various parts of the chapters upon special subjects have been submitted to Messrs. Furnival & Co., Linotype & Machinery Limited, Geo. Mann & Co., J. Ratcliff & Sons, R. Hoe & Co., Lanston Monotype Corporation, Albert & Co., C. G. Röder, Ltd., Hunters Ltd., Penrose & Co., F. Horsell & Co., Algraphy Ltd., to whom my sincere thanks are due for their generous assistance in supplying blocks and details, and in revising the articles.

The title "Metalography" has been adopted instead of "Metallography" which might be objected to, as it is already used in the metallurgical profession with quite a different meaning; whilst in the records of the Patent Office it is used as expressing printing from metals.

As it is desirable that a record such as this should be accurate in historical as well as manipulative facts, readers are invited to favour the author with corrections which may seem desirable, before it is issued in further editions.

November, 1909. CHAS. HARRAP.

PREFACE TO THE SECOND EDITION.

In placing before the trade a second edition of this work, I beg to thank various correspondents for their favourable criticisms, and in accordance with their suggestions have made certain alterations with a view to bring the notes literally up to modern discovery and practice. Further, Chapter XX has been replaced by two new chapters upon the latest developments of Offset Rotary and Flat-bed printing. These should be of practical value to the printers of to-day.

March, 1912. CHAS. HARRAP.

PREFACE TO THE THIRD EDITION.

In submitting the third edition of this text book under the title of "Offset Printing from Stone and Plates," it is to clear away any misconception which may have arisen by using the title "Metalography." The great strides made since 1912 in offset printing machinery and other appliances relative to printing from metal plates make it necessary to record the improvements made in the last fourteen years. There has been a steady demand for this book for the last eight years, but the peculiar effects of the Great War have delayed its publication; now that letterpress printers are installing offset plant it is deemed advisable to essay a third edition. The revision of the whole work has been supervised by practical men and in almost every case machine and other manufacturers and inventors of special processes have had the matter submitted to them before it was published.

My very sincere thanks are due to the many firms and individuals who have so generously assisted in the production of this work. Especially I should like to record my obligations to my old colleague, Mr. James Crawford, M.B.E., of the War Office, whose assistance has been invaluable.

The advances made in photography and its appliances call for much more exhaustive treatment. The chapter on this subject will be found to cover all the ground necessary for the ordinary printing works and includes particulars of the use of paper negatives.

Further, the discoveries made in the methods of planographic printing from dry surfaces are fully explained.

Personally I am of opinion that the term "lithography" should be wholly confined to printing from stone (lithos=stone) and that the comprehensive term "planography" should be used to include lithography, zincography and aluminography. The word "lithographic" appears to be quite inapplicable to rotary offset machines.

Lastly, I may say that I specially desired to mark my fiftieth year as a craftsman in the printing trade by this publication, which in all ordinary events is likely to be the last edition of this work which I shall make.

CHAS. HARRAP.

CONTENTS.

Page

PREFACE v

INTRODUCTION xi

CHAPTER I.—Lithographic Stone 1

CHAPTER II.—Aluminium 6

CHAPTER III.—Zinc 12

CHAPTER IV.—Printing from Metals—
Brief Introduction 18

CHAPTER V.—Grinding and Graining Plates—
Various Machines... 19

CHAPTERS VI, VII and VIII.—Zinc—Treatment in the Press, Originals, Transfers, Alterations, Additions, Transpositions, Set-offs, Printing, Storing ... 31, 36, 40

CHAPTERS IX, X, XI.—Aluminium—Treatment in the Press, Originals, Transfers, Alterations, Additions, Transpositions, Set-offs, Storing ... 44, 47, 53

CHAPTER XII.—Printing from Metals—Dry Lithography, Pantone 57

CHAPTER XIII.—Special Plates and Solutions—
Moller's "Litho Plates," 1883 64
Penrose's "Litho Zinc" Plates 66
Parker Printing Plates 70
Algraphy Plates 73
Bedplates 76
Zetch 79
The Strecker Process and L-AN-B Method 80
Winstone's "Victory" Etch 87

CHAPTER XIV.—Notes on Chemicals—Acids, Alkalis, Driers, Metals, Alcohol, Ether, Turpentine ... 89

CHAPTER XV.—Recipes 107

Page

CHAPTER XVI.—Tabulated Treatment of Zinc and Aluminium 115

CHAPTER XVII.—Photography on Metals—Whirlers, Printing-down Frames, Actinometer, Step-and-Repeat Machines, Multi-Negatives, Typary and Typon Methods, Paper Negatives, Photo-Composing (type) Machine 118

CHAPTER XVIII.—Rotary Machines for Offset and Tin Printing—

George Mann & Co. 177
R. W. Crabtree & Sons 188
Furnival & Co. 196
Linotype & Machinery, Ltd. 203
John Ratcliff & Sons 207
Waite & Saville 213
J. & S. Eyres 217
Marinoni-Voirin (F. Connolly, Ltd.) 218
"Harris" Offset Rotary 228
R. Hoe & Co. 232
Fuchs & Lang 238
Premier-Potter 238
"M.A.N." Augsburg-Nurnberg 240
"Bautzen" Johne-Werk Co. 247
"Vomag" 247
J. G. Mailander 251
Albert & Cie. 253

CHAPTER XIX.—Electric Motors—Electromotors Ltd., British Thomson-Houston Co., J. H. Holmes & Co. 257

CHAPTER XX. — Feeders — "Universal," "Dexter," "Camco," "Cross," H.T.B. Ltd., Semi-automatic and "Slogger" 266

CHAPTER XXI.—Working of Offset Rotaries—Blanket, "Ideal" and other Rollers, Reversing Methods ... 281
Reversing and Proving Presses—Waite & Saville, Crabtree, G. Mann, Marinoni-Voirin, Penrose, Fuchs & Lang, Faber & Schleicher 294
Lighting—Mercury Lamp, Fade-Ometer 308

INTRODUCTION.

In essaying to deal with the subject of printing from metals, it is not because there is any special novelty in the process to record, but rather to bring together the experience of numerous workers upon zinc and aluminium all of whom have special qualifications for regarding them in the light of more than usually successful workers and investigators. It is unnecessary to say "that hitherto printing from metals has been more or less unsuccessful," because that is entirely beside the mark. The use of zinc as a printing surface is mentioned by Senefelder in his German work of 1818, and it is practically certain he had worked on zinc in 1817, if not sooner. He went still further, and produced zinc plates with coated surfaces. Such plates still exist, bearing Senefelder's own (manuscript) productions of music upon them, the drawing being of such an excellence as to indicate that he was a most painstaking draughtsman. It must further be admitted that plain zinc was experimented with, at least in England, from 1819, for in 1826 the following letter of H. Rowan, Leinster Street, to Captain Stisted, shows that some more than ordinary plain work was then being produced.

> *Mr. Hamilton Rowan presents his compliments to Capt. Stisted. He at length sends a polished plate of zinc, which he has at this moment received from Mr. Grubb, in order to induce Mrs. Stisted to exercise her pen or pencil on ; to effect a more portable repository of drawings, and as he supposes from the enclosed sketch as permanent as those drawn on or transferred to stone. The drawing he sends was transfer and on a very ill-polished stone. This perhaps may have been in its favour, and would not be a singular instance of high polish destroying intrinsic merit.*
>
> Leinster Street,
> 19*th Aug.*, 1826.

There is little doubt that zinc was continually in use and has not at any period fallen into desuetude. In 1829 Breugnot, of Paris, printed large geographical charts from zinc. Between 1830 and 1840 zinc was used by Day & Son for railway views. In 1835 Chapman & Co., 20 Cornhill, published a drawing on zinc, by their "patent" in the *Railway Magazine* of May, 1835. Whether they really had a patent is somewhat difficult to say. And quite recently some chromo specimens have been exhibited with the imprint, del. et zinco, 1838. Again, the Ordnance Surveys were commenced in 1747, and improved in 1783. In 1797 the first map of Great Britain was put in hand. The survey of Ireland was ordered in 1824; and in 1840 Scotland and the Northern Counties were commenced. But in 1855 surveys were ordered on the 1 in., 6 in., and other larger scales. The headquarters of the survey were at the Ordnance Survey Office, where it is well known that from an early date the 6 in. survey was printed from zinc. In fact it was probably used some years previous to its adoption for the $\frac{1}{2500}$ scale maps, in 1855. This shows that zinc has been successfully used for a long time, not only at Southampton, but elsewhere. It was used at Nottingham in the early days of lithography; and in 1870 it was practically almost as well known as printing from stone. Patents of machines before 1857 include the process of zincography coupled with lithography. Coming to more recent times, when Möller's patent (1883) was exploited by C. & E. Layton, zinc became common, and as one of the earliest workers upon patent coated zinc plates, I may record that the zinc plates of that day, whether coated or plain, were successfully manipulated to no small extent. Improvements have been made in various directions, but even forty years ago Dickes pointed out the use of silicates in treating zinc, to make a surface like stone and repellent of ink when damp.

Methods have been improved, but the principles have been but little altered during the whole time the metal has been in use. With aluminium it is not quite the same. The

metal has only been known in a popular way for less than 65 years, and it was not actually introduced in the printing trade until Mullaly and Bullock's patent of September 8th, 1891. At that time it is easy to recall the deprecatory remarks of men "who had been using aluminium before that time," to use their own words, when trying to show that the patent was untenable. Such remarks, however, need carry no weight, for it was not so. It may be stated that experiments with an alloy of aluminium and zinc were conducted in 1891 in Berlin. When I visited every lithographic firm in Liverpool—and the whole West of England from Carlisle to Plymouth, as well as most of the Midland towns—in the summer and autumn of 1892, the only mention of any actual usage of aluminium was made by the late Paul Richter, then at the Liverpool Printing & Stationery Company's house. It was then spoken of as quite a new introduction. And it may be readily inferred that it was due to Mullaly & Bullock's invention, as an account of this novelty had appeared in the printing trade journals, consequent upon the taking out of the British patent 15,238 in 1891. The progress of aluminium has all occurred since 1897 and its use even at the present day (1909) is comparatively restricted. About 1898 the Aluminium Litho-Plate Co., of Liverpool, were dealing in plates.

As to whether zinc or aluminium is to be preferred to stone from the workers' point of view, there are no two opinions. Stone is undoubtedly the best.

In dealing with plates versus stones, the advantages in many respects are very great. This was fully recognized in 1887, when the Litho-Plate Co. set out at length the following points of vantage:—

"Work can be transferred to them with even sharper and clearer results than from stone.

"There is no tendency for the work to spread, nor does it become weakened, remaining perfect after many thousands of impressions.

"Work engraved can be printed in the press or machine.

"Originals can be stored in small compass. Much time is saved in making offsets, and artists can work on them more conveniently.

"There is no risk of breakage, like stone.

"Their portability is very advantageous; [as plates can be sent to and from any part of the country for drawing and printing at much less cost and risk].

"Photo-lithographers can transfer their work upon them.

"The treatment [of litho-plates] is nearly the same as stone.

"Their price is much less than stone.

"They can be re-coated at about the same cost as re-polishing [and may be used for several designs before re-coating]."

Add to this their adaptability for direct photography, and for half-tone and collotype transfers, to complete the list of what might be termed advantages.

From the economic aspect metal must be used if planography is to retain its position as a competitor of or aid to typography. The necessity for more expeditious production has been the impetus for the invention of rotary machines of such high standard as now exist. And it may be added that not a few of the houses which held but minor positions at the commencement of the century, have grown to respectable dimensions, and to take rank with large and old concerns, owing to their judicious use of rotary machines. Such progress in planographic printing has placed the craft in a still better position than ever it held, with a proportionately larger number of artisans employed, and with a ratio of unemployment which compares very favourably with any other skilled handicraft.

The fact that rotary machines exist, of enormous capacity of output, and that metals are so well understood that many

artisans can manipulate them, it may be taken for granted that printing from metal (Metalography) is and will continue to be a very important part of the printing industry, and deserves to be dealt with in all its phases, as attempted in the following chapters.

To further draw distinction between the metals themselves as to which medium to adopt, it is necessary to always follow the course of least resistance. When aluminium was introduced in 1892, and more recently in 1898-9, many features were claimed for it, as advantages over stone, not to say zinc. It was then contended that its superiority to zinc was sufficiently clear, that it was to be pressed forward as the one substitute for stone. But printers did not see eye to eye with these contentions.

Efforts were made by that well-known investigator of zinc printing—Mr. G. H. Block—which resulted in the production of zinc plates of the best quality ever put upon the market. On the other hand the manipulation of aluminium was not so simple nor so certain as zinc. Aluminium therefore only obtained a slight hold of the trade, which has progressed gradually since 1900. But the impetus given to Metalography had its effect on the use of zinc, especially as zinc was so much cheaper, and, which is of far greater importance, the use of zinc had become so popular since 1885 that most craftsmen were accustomed to it in the plain or prepared form. There were many men in Great Britain well known to the writer who used zinc plates for all purposes with the greatest success, many of whom, again, preferred zinc plates to stone for certain purposes. It is noticeable, too, that O. C. Strecker, in his patents of 1900 and 1902, especially the latter, singles out zinc as the metal of his preference, and Mr. G. H. Block's patents from earlier dates dealt with zinc as the most suitable metal. Under such varying opinions experiments have been conducted for some years with tyros in Metalography, and the results of such experiments prove conclusively that with equal instruction

given upon zinc and aluminium, the results are equally as good from either metal.

One more consideration of Metalography is of such importance as to claim the attention of the whole trade. Machines for lithographic printing have been improved during the past fifty-six years so rapidly that forty-nine years ago—long before attention was given to letterpress machinery in the same direction—they were capable of producing any subject in seven to thirty printings with comparative accuracy of register. The rotary machines proper, which commenced with T. R. Johnston's machine of 1895, have always had accuracy of register as of paramount importance. So it may be taken that any rotary machine of to-day will print any number of colours with almost accurate register. This point places the rotary machine in a position that it is the handmaid or assistant of any letterpress printer who desires to combine the mechanical products of the letterpress machine with the soft transparent colourings of the lithographic printer. In other ways this combination of letterpress and lithographic printing can be utilized almost *ad infinitum*, to the benefit of the employer. So varied is the application that it would seem impossible for a letterpress printer or lithographic printer to exist as a separate concern without its co-partner. The letterpress printer who has to print many subjects at one time fails to recognize the ease and cheapness with which lithography can be brought to his aid, whilst lithographic printers who aim for the accuracy and clearness of half-tone block work, fail to appreciate the true co-operation of the kindred craft.

With both machinery of the highest type, and methods of great perfection, the future of both letterpress and lithographic printing should have no drawbacks. The proper combination of both, coupled with a living interest in the trade, on the part of employers and employees alike, cannot fail to give a long and prosperous career to all engaged in the printing trades.

OFFSET PRINTING.

CHAPTER I.

LITHOGRAPHIC STONE.

THE basis of surface (planographic) printing is undeniably chemical. There is scarcely any better proof of this than the processes of printing from the surfaces of zinc and aluminium and stone. It becomes the more apparent when any attempt is made to print from glass, wood, or other metal surface. Although there are some points in common, mainly due to the same kind of transfer ink being used, yet the general treatment of stone, zinc and aluminium has marked differences, due to the variation in the chemical action or affinities of the material used. To make this clearer; the composition of lithographic stone may be roughly taken as calcium carbonate (a body, the principal constituent of chalk, marble, sea-shells, coral, and other rocks in the earth's crust) with about a 3 per cent. admixture of magnesium carbonate and traces of iron salts, with silicates of alumina, etc., sodium and potassium chlorides. So small a quantity of magnesium carbonate may seem not worth notice: but when a stone weighing rather more than 1 cwt. (say 130 lbs.) is analysed, it will be found to contain 4 lbs. of magnesium carbonate, or a quantity sufficient to heap up in a thick powdery layer all over the stone. It may be the presence of the magnesium carbonate, or the physical texture of the stone resulting from the peculiar conditions under which it was formed at the bottom of some inland sea or estuary, that makes the appreciable difference between lithographic stone (or "slate") and the other forms of calcium carbonate, such as marble, which fits it for surface printing. As compared with zinc and aluminium it is a complex compound capable

of various chemical actions. It may be used for the manufacture of carbon dioxide (CO_2) for the preparation of aërated waters. It may be used as the means of obtaining the little required metal, calcium (Ca). This metal is a strongly alkaline, silver-white substance, similar in properties to potassium, but harder. Potassium (K) metal when thrown on water immediately becomes hot and bursts into flame, as it unites with hydrogen (H) and oxygen (O) in the water to form caustic potash or potassium hydrate (KOH), a material so caustic that it will partially take the skin off the hands. Calcium is not quite so active, as it decomposes water much less vigorously, even than sodium.

Calcium is allied to barium (Ba) and strontium (Sr), these three being the group of alkaline earth metals. From lithographic stone can be prepared quicklime, or calcium oxide (CaO) which unites with water to form calcium hydrate [$Ca(OH)_2$], a substance which is a powerful alkali, almost as strong as caustic soda (NaOH) and potash (KOH). And amongst the many compounds of calcium formed by treatment of carbonates with acids may be mentioned gypsum, alabaster, sulphide (luminous paint), phosphate (in human bones), and sulphate and bi-carbonate giving hardness to water. It is largely due to its complex character and it being a basic rock that lithographic stone is suitable for its work in surface printing. A compound such as calcium carbonate and magnesium carbonate, as naturally found in lithographic stone, is more easily attacked by chemical agents than its outward appearance would seem to convey. It is a body rather susceptible to change when treated with substances having a chemical affinity for its constituents. Thus, being an alkaline earth, when treated with acids it readily forms salts and loses its gaseous constituent, carbon dioxide (CO_2). This is so much the case that even some other compounds, which are themselves only loosely combined, will break up when placed on lithographic stone, the acid constituent combining with the calcium of the stone, and the basic constituents in some cases combining with the gaseous part (CO_2). In all such interactions there are considerable divergences in the vigour of the chemical actions, and in the stability of the products formed. This may be illustrated by the action of a few acids on stone. When the stone is treated with oxalic acid ($C_2H_2O_4$) the

immediate action is almost imperceptible, but the salt formed, viz., oxalate of lime, or calcium oxalate (CaC_2O_4) remains on the surface of the stone, strongly adherent, forming a glaze which can be turned to good uses in the course of printing. In using acetic acid ($C_2H_4O_2$) an acetate of calcium [$Ca(C_2H_3O_2)_2$] is formed: this substance being very soluble in water, and at the same time disposed to adhere, it will often form a thin film on the stone, which proves disastrous in subsequent operations. With sulphuric acid (H_2SO_4), calcium sulphate ($CaSO_4$) is formed, a fine dusty compound which may or may not be easily washed off, whilst the acid's action seems to give, more or less permanently, a crumbling action in the surface of the stone. With hydrochloric acid (HCl) the stone is rapidly acted upon and converted into calcium chloride ($CaCl_2$), which is soluble in water, giving the same results and the same dangers as when acetic acid is used. The action of citric acid ($C_6H_8O_7$) produces calcium citrate [$Ca_3(C_6H_5O_7)_2$], a powdery substance which has little or no tendency to cling to the stone, and is readily washed off. With phosphoric acid (H_3PO_4) the phosphate of lime [$Ca_3(PO_4)_2$] is formed, which is similar in behaviour to citrate of calcium. Tartaric acid ($C_4H_6O_6$) in forming calcium tartrate ($CaC_4H_4O_6$) yields a body again similar to citrate of lime; but when nitric acid (HNO_3) is used the action is very vigorous, possibly oxidising the grease or scum, and converting the superficial layer of the stone into calcium and magnesium nitrates, which are very soluble in water and easily washed off with water without any fear of leaving either a crystallizable or adherent compound. Thus in summarising it will be seen that nitric, hydrochloric and sulphuric acids act vigorously; citric, phosphoric and tartaric acids act slowly; acetic acid, still more slowly; and oxalic acid, almost imperceptibly; that hydrochloric, nitric and acetic acids form soluble compounds and the others form insoluble compounds; that oxalic acid forms an adherent compound; acetic and, to some extent, sulphuric acids form compounds which are very difficult to remove by washing; whilst citric, tartaric, phosphoric and nitric acids form non-adherent compounds.

In further considering actions upon stone exerted by compounds, there are some four or more materials in common use affording illustrations of how one compound will break up in the presence of another and suffer an interchange of

constituents. When gum arabic solution is put on lithographic stone, especially when used after an etch, there is reason to believe that the potassium (K) of the gum unites with the carbon dioxide (CO_2) of the stone, forming potassium carbonate (K_2CO_3). This action liberates some arabic acid from the gum, which, in turn, may act on the calcium carbonate of the stone and form therewith calcium arabinate, or a modified gum, actually in the stone's surface. In treating stone with bi-carbonate of soda ($NaHCO_3$) the "soda" emulsifies any grease on the stone, or even gum on the stone, so that a mere wash of water leaves the surface fresh and clean. In the same way whiting ($CaCO_3$) rubbed on a stone will by abrasion clear away any film and give a fresh surface even better than the soda. When alum [$Al_2 (SO_4)_3 K_2SO_4$ 24 H_2O] is applied to lithographic stone, an action proceeds very similar to that of the less vigorous acids, owing to the presence of a little free sulphuric acid; but it has other undesirable results which should preclude its use from most lithographic printing processes. Solution of aluminium sulphate has been used satisfactorily, in the same way as "Liasine" is used, on stone.

In dealing with the chemical actions of stone, the matters so far discussed have been acids and compounds of a basic and acid character. But there is another series of re-agents known as alkalis whose action has not been described. The alkalis are best represented by the bodies caustic soda (NaOH), caustic potash (KOH) and ammonia (an aqueous solution of NH_3). These bodies have a tendency to decompose fats, because fats contain fatty acids with which an alkali will form a compound—frequently a form of soap. When alkaline solutions are placed on stone, little or no action takes place. But, as already stated, alkalis act on fats, or fats on alkalis; so when transfer ink is placed on stone, the free fatty acid present will attack the calcium and magnesium carbonates ($CaCO_3$ and $MgCO_3$) of the stone and form, not a soap in the ordinary acceptance of the term, but a permanent calcium or magnesium soap. The new compound formed by the fatty acid and the calcium or magnesium of the stone is a somewhat stable or permanent one. It penetrates the stone and in course of time "sinks" so deeply that the surface of the stone may be polished off, and subsequently the whole subject may be again brought into printing condition. This

new compound is not soluble in hot or cold water; in fact it repels water, whether pure or mixed with gum or dextrine. It behaves like a grease. Usually the work is well rolled up, preferably with black ink, before any chemical of a destructive or corrosive character is applied, and when so rolled up it will withstand considerable attacks of acids. But when rolled up, the ink can be readily removed by turpentine or its substitutes; and if this "washing out" be repeated several times successively, it will have a very appreciable result in weakening and damaging the work. If newly drawn work be carefully treated with benzine it may be quite dissolved from the stone. The strong acids will destroy the work readily; but when the work has been well rolled up and dusted with talc, these strong acids even at 10 per cent. strength have little or no effect on the work, but by constant application will dissolve the stone sufficiently to undermine the work and weaken it. Upon these interactions is based the whole art craft of printing from lithographic stone.

The object of treating this matter at such length is to show how different re-agents act upon the lithographic stone, and to finally show the chemical basis of the power to use stone for printing. In dealing with the metals much of this detail may be omitted, provided that the illustrations of the treatment of stone are always kept well in view.

CHAPTER II.

THE METALS. I—ALUMINIUM.

THE general character of the metals aluminium and zinc presents a distinct contrast to lithographic stone. Both of them may be used in thin sheets or plates, providing proper means of attachment or mounting are available. They are, so far as chemical knowledge at present exists, practically pure metals, and are actual elements. They are the metals extracted from their earthy compounds, just as metallic calcium may be extracted from lithographic stone. Being elements there are much fewer possibilities of secondary chemical actions, than is the case with a compound such as lithographic stone. And, further, the chemical affinities of an elementary metal vary considerably with the re-agents used for stone, whilst some re-agents which act upon stone feebly or not at all, have quite another action on these metals.

Aluminium as a metal has not been known as long as lithographic stone, for it was only in 1827 that it was first discovered. Its early method of extraction was so expensive as to preclude its general use, and although electrical methods of procuring it were patented in 1885, yet it was not until the Héroult-Hall method was introduced that any great advances were made in its common application. In 1890 the world's output of aluminium was 40 tons, and the price was 9/6 per lb. In 1900 the output was nearly 6,000 tons, and the price had fallen to 1/4 per lb. In 1907 one authority estimated the annual output at over 15,000 tons, of which Canada produced about 3,000 tons, and foreshadowed a rise in price. These two dates mark epochs in the use of aluminium as a printing surface. 1890 just preceded Bullock and Mullaley's patents of 1891, when aluminium was first well brought to notice for printing purposes; and 1900 was just subsequent to the methods of Strecker and Christian Scholtz, which undoubtedly made aluminium a much more satisfactory article for surface printing; and since that time there has been a

regular progress in its adoption. Aluminium (Al) is very light, having a specific gravity of 2.7, whilst zinc is 7.1. Its atomic weight is 27.1, as compared with zinc at 65.4. As further illustrations of its weight it may be stated that the atomic weight of gold is 197 and of lead 206.9. Amongst its various properties may be mentioned that it melts at 654° C. and at 100° to 150° C. it is very malleable. It is frequently impure from the presence of iron, silicon, carbon, copper, zinc and lead. When pure it is slightly affected by the air, and at high temperature it readily forms the oxide (Al_2O_3). It is a greyish white metal, not very brittle, in thin sheets; without taste or odour; and capable of taking a fine polish. As some indication of its hardness and other qualities it may be mentioned that aluminium oxide occurs naturally as corundum; and with ferric oxide as emery. The same oxide when coloured with chromium and cobalt salts, is found as ruby and sapphire.

Aluminium hydroxide [$Al_2(OH)_6$] is used for precipitating "lakes" upon, and is used as a mordant in dyeing processes. And aluminium sulphate [$Al_2(SO_4)_3\,18\,H_2O$] is a white powder used in paper making. One other common compound is the double salt of aluminium with either potassium, sodium, chromium, or ammonia, and sulphuric acid, known respectively as alum, soda alum, chrome alum or ammonium alum. Aluminium is of world-wide distribution as it is the common silicate of clay, as well as occurring in gems, in cryolite, bauxite, diaspore, gibbsite, mica, zeolite, felspars and china clay, and constituting little less than one-twelfth of the earth's crust in compound forms.

Touching those features of aluminium which appeal directly to the printer there are its physical characters which have frequently caused some doubt as to its suitability. Although often considered wanting in tenacity, it will withstand 12 to 15 tons to the square inch, and in tension its strength lies numerically between that of best steel and iron wires. It is not surprising, therefore, that at 40°C. (104°F.) its coefficient of expansion is only .002313 for every rise of one degree in temperature. If a sheet of aluminium were 1,000 inches long, a rise of temperature of 1°C. would increase its length 2 inches, or, put in another way, it increases only $\frac{1}{500}$th of its length for every rise of 1°C. The stretching of a sheet of aluminium when being run in the machine is so

infinitesimal that it need not be considered. For use in printing, aluminium has a small percentage of tin added. Most metals oxidise in the air, if only slightly, and aluminium is no exception. Most metals combine with sulphur in the air, forming usually blackened sulphides, as bronze for instance, but aluminium does not. A peculiar feature of aluminium, however, is that if sprinkled with drops of water and the water allowed to dry, the spots so formed will ultimately take ink. And, although aluminium is not generally considered to oxidise in the air, yet, if it be kept even well wrapped up, the surface becomes affected, or becomes stale, with a thin transparent film of oxide, and is unfit to draw or transfer upon until scoured with a fine gritty dust, such as pumice powder. The oxidation of aluminium in air is the difficulty which has been met with in soldering aluminium, and is well known to metal plate workers.

In the actual treatment of aluminium its chemical characteristics are of the utmost importance, because it differs so much from lithographic stone.

Aluminium treated with nitric acid is not affected more than very minutely if allowed to act for twelve months. The action then, most probably, is only the decomposition of minute particles of impurity in the metal, and not an action on the metal itself. This difference from lithographic stone at once causes a considerable alteration from the common practice of lithography, and to serve the purposes of nitric acid on stone another re-agent must be used.

Aluminium treated with hydrochloric acid (HCl) is immediately attacked vigorously, and a small slip of thin aluminium in a test tube is entirely dissolved in two minutes.

Aluminium treated with powdered phosphoric acid (H_3PO_4), and water added, evolves heat, gives every opportunity for chemical action, yet the aluminium is apparently unattacked.

Aluminium with the organic acids, acetic ($C_2H_4O_2$), citric ($C_6H_8O_7$) and oxalic ($C_2H_2O_4$) tested separately shows no action, but on the addition of common salt (NaCl), a slight decomposition occurs.

Aluminium with concentrated sulphuric acid (H_2SO_4) apparently shows no action. But upon adding water, heat is evolved, and a strong decomposition is set up.

Aluminium with caustic potash (KOH) immediately commences a steady decomposition.

Aluminium with caustic soda (NaOH) acts exactly the same as with caustic potash.

These are the results of experiments performed in a way that anyone can follow, and with the results stated in ordinary terms, rather than in chemical phraseology. Aluminium, when treated for a little time with caustic soda, becomes fibrous and can be pulled apart in rough threads.

To appreciate to the full the nature of aluminium, the chemical investigation must, however, be carried to its furthest possible extent. Its compounds and its occurrence in nature must be studied, and their re-actions must be taken into full account.

Aluminium is unaffected by hot or cold water, but under pressure with steam a slight decomposition may occur. Sulphuretted hydrogen and a few other sulphides fail to attack it. Most metals are readily precipitated by both sulphuretted hydrogen (H_2S) and ammonium sulphide. In fact, it is only upon fusing aluminium with sulphur (S) or oxygen (O) that the compounds are formed. Aluminium oxide (Al_2O_3) may be produced by the fusion of aluminium in the air, or by fusing (igniting) ammonia alum [Al_2 $(SO_4)_3$ $(NH_4)_2$ SO_4 24 H_2O] or aluminium sulphate [Al_2 $(SO_4)_3$ 18 H_2O] to white heat. This oxide in its amorphous state, after being heated, is slightly attacked by sulphuric acid (H_2SO_4) and hydrochloric acid (HCl). It may also be obtained in a crystalline form by heating to a high temperature a mixture of aluminium fluoride (Al_2F_6) and boron trioxide (B_2O_3). In the crystalline form it is similar to the gems, rubies and sapphires. It is nearly as hard as diamond, and unattacked by any acids. Aluminium oxide may act as a feeble acidic oxide under certain conditions; but aluminium forms compounds known as hydrates (hydroxides), two of which bring it into a condition where it can be dealt with more on the lines of other metals. The aluminium dihydrate (Al_2O_3 2 H_2O) is apparently a feeble compound of aluminium oxide with water. This hydrate when freshly precipitated is easily

soluble in acids, and even forms salts with acetic acid ($C_2H_4O_2$). But the aluminium trihydrate (Al_2O_3 3 H_2O) is a soft, bulky, friable mass which, when freshly prepared, is readily acted upon by acids, potash and soda. It is these hydrates which make it possible to deposit the aluminium oxide upon fabrics, in combination with colouring matters, as in dyeing.

As a direct comparison with zinc, it may be pointed out that whilst solutions of caustic potash (KOH) or caustic soda (NaOH) will produce zinc hydrate [$Zn(HO)_2$] from zinc sulphate ($ZnSO_4$), aluminium hydrate treated with caustic potash forms potassium aluminate ($Al_2K_2O_4$); and that similar aluminates occur naturally, as spinel, the magnesium aluminate (Al_2MgO_4), and galinite, the zinc aluminate (Al_2ZnO_4). Such characteristics seem to place aluminium in a different aspect. They apparently give it the property of an acid capable of forming salts with a base. More especially may this be inferred as it forms a salt of zinc.

Alums are double salts, consisting of aluminium sulphate [Al_2 $(SO_4)_3$] and the sulphates of sodium (Na_2SO_4), potash (K_2SO_4), or ammonium [$(NH_4)_2$ SO_4], in each case with 24 molecules of water (24 H_2O), which would seem to indicate that whilst the sodium, or potassium, or ammonium sulphate may be considered as the basic compound, the aluminium sulphate may be considered as the acid compound.

This discussion of aluminium and its compounds, and in other forms where, apparently, it is of no importance to the printer, has been entered upon to determine, as far as possible, the true light in which aluminium must be viewed as a chemical agent. To still further assist in this determination, it may be added that aluminium unites with the non-metallic element bromine (Br) to form aluminium bromide (Al_2Br_6); also with the non-metallic element fluorine (F) to form aluminium fluoride (Al_2F_6); whilst a double salt of aluminium and fluorine with sodium (Na) occurs in Greenland as cryolite (6 NaF Al_2F_6). To these non-metallic attachments may be added the large number of aluminium silicates, including kaolin, porcelain or china clay (Al_2O_3 2 SiO_2 2 H_2O), staurolite (4 Al_2O_3 SiO_2), andalusite and kyanite (Al_2O_3 SiO_2), and allophane (Al_2O_3 SiO_2 6 H_2O).

It has been shown that aluminium is not, like many metals, readily attacked by most acids, yet it is easily acted on by

alkalis; that aluminium oxide is a feeble acid; that aluminium forms compounds with alkalis, non-metals, and some metals (magnesium and zinc); that alums have an acid reaction. It may, therefore, be regarded as standing in an intermediate position between elements of acid and basic ["alkaline"] character, and bordering very closely upon the non-metallic acid-forming state.

CHAPTER III.

II—ZINC.

Zinc (Zn) is nearly three times heavier than aluminium, having a specific gravity of 7.1. Its atomic weight is 65.4. It melts at 419°C., a temperature which is much more easily reached when using bunsen burners for heating purposes, than is generally supposed. Pewter, which is an alloy of tin, antimony, and a small amount of copper, melts at a lower temperature. This is the metal used for music engraving. Zinc boils at 925°C. and then volatilizes. If zinc be heated in air, in a bunsen flame, it burns with a greenish flame, forming the white flaky substance, zinc oxide, or permanent Chinese white (ZnO).

Zinc or spelter is a bluish-white crystalline metal, of a brittle character, but at temperatures between about 120°C. and under 200°C. it becomes malleable, and, after being made malleable, it retains that character when cold.

It is prepared from blende (zinc sulphide, ZnS) and calamine (zinc carbonate, $ZnCO_3$) by roasting in air, then calcining with coal to liberate the metal. It is generally associated with lead in its natural state, but zinc volatilizes and can be driven off from impurities and distilled practically pure. As zinc is scarcely affected by the air or weather, its use in galvanising, or plating iron is very extensive. Zinc, too, forms a constituent of brass and other alloys, and is largely used as the negative pole in galvanic batteries.

Zinc treated with sulphuric acid (H_2SO_4) forms zinc sulphate or white vitriol ($ZnSO_4$) and liberates hydrogen gas. This is used as a drier in pigments; its properties being taken advantage of as an eye lotion, and for sores and ulcers. It is also used in calico printing as a mordant. With hydrochloric acid (HCl) it makes zinc chloride ($ZnCl_2$), used in tinning and soldering as a flux. This compound is also known as zinc butter. It has caustic properties, acting as an irritant poison; but it is also used as an antiseptic, under the

name of Burnett's disinfecting fluid. Its property is that of withdrawing the elements of water from organic matter; and when used in the solid form is a caustic.

The native ores containing zinc are found in large quantities in Great Britain, Silesia, around Aix-la-Chapelle (Aachen), Belgium, France and Spain.

Zinc, as a chemical element, is practically pure. The purest product is not affected by acids to the same extent as less pure forms. It is, however, attacked by most acids, but scarcely affected by alkalis. Some acids have a much greater affinity for it than others. Thus, with lithographic stone, it may be said that nitric (HNO_3) and hydrochloric (HCl) acids have the greatest action; so with zinc it may be equally accepted that sulphuric (H_2SO_4) and hydrochloric (HCl) acids have a particularly vigorous action. In treating zinc it should always be remembered that after extraction from the natural ore it has ultimately to be prepared in sheets which undergo much rolling. As a natural product, dealt with in the most expeditious manner to insure cheapness, there can be little guarantee of its uniformity. Even though it be pure and hard in parts, there are certain to be appreciable areas of softer metal. Such areas of softness, arising from unequal annealing in manufacture, are the areas first attacked by acids. This defect of zinc led to the practice of "amalgamating" zinc plates in galvanic batteries by coating them with mercury. In lithography such a method is not available, and printers have to rely upon manufacturers to produce plates as homogeneous as recent scientific discoveries will permit. In one feature alone zinc is better than aluminium, namely, in its very low coefficient of expansion. Whilst aluminium expands $\frac{1}{50}$th of its length for every 1°C. rise in temperature, zinc only expands about $\frac{1}{300}$th of its length for a similar rise; its coefficient of expansion being .000294.

In pursuing the study of zinc closely into its chemical reactions, as they affect the lithographic printer, experiments have been made to find to what extent re-agents attack it. The results of such experiments are briefly as follows:—

Zinc treated with nitric acid (HNO_3) is rapidly attacked by dilute solution and wholly dissolved.

Zinc treated with hydrochloric acid (HCl) is readily attacked by dilute solution; wholly dissolved; leaving a

comparatively large amount of dark, dirty residue of lead, originally an impurity in the zinc.

Zinc treated with sulphuric acid (H_2SO_4) is attacked gently by dilute solution; wholly dissolved; leaving a little dark powdery residue of lead.

Zinc treated with phosphoric acid (H_3PO_4) is attacked moderately by concentrated solution; partially dissolved; and a mass of flaky dark compound is formed in the solution.

Zinc treated with acetic acid ($C_2H_4O_2$) in concentrated solution is not attacked. When the solution is dilute, a feeble decomposition is set up on the clean-cut raw edges.

Zinc treated with citric acid ($C_6H_8O_7$) in strong solution sets up a feeble decomposition in the course of some time. No immediate action takes place.

Zinc treated with common salt (NaCl) in strong solution ultimately sets up a feeble decomposition.

Zinc treated with oxalic acid ($C_2H_2O_4$) in strong or dilute solution apparently gives no action.

Zinc treated with alum [$Al_2(SO_4)_2\ K_2SO_4\ 24\ H_2O$], or cold solutions of potash, potassium hydrate, caustic potash (KOH) or caustic soda (NaOH) or ammonia (NH_4OH), is apparently unattacked.

In stating these results no attempt has been made to enter into what does occur and what compounds are formed from the chemist's point of view, but simply the apparent results visible to any printer. It may easily be shown that zinc is slowly dissolved in hot solutions of caustic soda (NaOH) and caustic potash (KOH). And to show the complexity of one of these reactions it may be stated that when zinc is treated with nitric acid the following compounds and gases are formed, viz.: zinc nitrate, zinc nitrite, ammonium nitrate, ammonium nitrite, nitrous oxide, nitric oxide, nitrogen, etc.

Although it may be said that zinc withstands the effects of the air and weather, yet it is much more probable that the basic carbonate formed by such exposure makes an artificial surface protection.

Zinc is not attacked or acted on by the mineral lubricating oils, but is slightly acted upon by common animal oils. Metallic zinc will precipitate from their solutions many other

metals, e.g., arsenic, cadmium, copper, lead. In attempting to arrive at conclusions as to the use of zinc in printing, it is necessary to deal with some of its compounds. Zinc oxide (ZnO)—Chinese white—is insoluble in water, but dissolves readily in aqueous solutions of acids, forming the various zinc salts (compounds). It should be inferred, therefore, that zinc oxide and zinc itself are of a basic character. Lithographic stone has already been shown to be a compound of a basic character; so that, roughly, a chemical similarity appears to exist between zinc and stone. When zinc sulphate is treated with the alkalis, caustic soda or potash or ammonia, a hydroxide of zinc [$Zn(HO)_2$] is formed, resembling in chemical formula the three alkalis above, represented respectively by the formulæ NaOH, KOH and NH_4OH. Further, in the principal alums, where aluminium, iron chromium or manganese, take part with sodium, potassium or ammonium in the formation of the salt, zinc does not appear. Yet, in the pseudo-alums, one exists in which the iron compound seems to have the acid function, and the zinc compound takes the basic, thus:—$ZnSO_4$ $Fe_2(SO_4)_3$ 24 H_2O.

Zinc, as used in printing, is rolled into moderately thin plates, varying from 19 to 29, measured by the Birmingham Wire Gauge, 25, 22, and 19 being the usual stock gauges according to the superficial dimensions of the plate. Very thin metal up to 38 B.W. Gauge is being used for offset rotary machines. The makers of the Parker printing plates have now placed upon the market zinc plates of 34 B.W.G. (.009 in.), and other plate makers have followed the same course. A plate of 36 to 38 gauge is made for reversing purposes.

25 B.W. Gauge ...	Thin	.020 in.
22 „ „ ...	Medium	.028 in.
19 „ „ ...	Stout	.040 in.
16 „ „ ...		.064 in.
15 „ „ ...		.072 in.
14 „ „ ...		.080 in.

Zinc plates can be conveniently cut in a bookbinder's card-cutting machine, or by a suitable saw. The brittleness of zinc is, to some extent, a disadvantage in bending it on

the bedplate, and frequently it breaks, even though only at the surface. But, as it is so little affected in the ordinary air, it has a distinct advantage over aluminium in general workshop usage. The edges of thin zinc which have to be placed in rotary machines should be folded over about quarter of an inch. Zinc may be used in its raw state equally as well as any of the prepared zinc plates. There is little doubt that since Möller's patent zinc plates in 1885, that all the variations in the surfacing and preparing of zinc have been well tried. Some have held favour for a much longer period than others, such as the Hull zinc plates; and, as an outcome of their manufacture may be mentioned G. H. Block's zinc plates, which are, undoubtedly, the best form of chemically prepared zinc plates printers have used. These plates although chemically prepared, when treated in the same way as raw zinc plates give better and firmer results. The advantage of these prepared plates is the care exercised in their preparation and the comparative whiteness of the surface. It is unnecessary to state that neither artist nor printer prefers a zinc plate to a stone, whose natural characteristics are such as to place it always in the first place for drawing upon and printing from.

Zinc has been used polished, but its inability to retain moisture evenly on the surface makes it very difficult to work. It is recommended always to have it grained. The graining is a mechanical process, and may be done by hand as for stone, or by the graining machines as made by Messrs. Furnival, Mann, Horsell, Ratcliff, Linotype & Machinery, Hunters, Marinoni-Voirin, Greig, the American firms, McKinley & Co., Fuchs & Lang, and some of the large German printing machine manufacturers. The sandblast was very effective when carried out in Tilghman's machine. But, under general conditions, the sandblast does not give that peculiar uniformity and character produced by hand or machine. The sandblast works upon zinc as it does upon glass, by actually cutting pieces out of the plate. The general surface of the plate retains a comparative evenness, whilst the "grain" consists of a number of little indents resembling the curious borings of the paper by the bookworm, and all of them the same depth. On the other hand, the zinc grained in the machine seems to present a crumbly mountainous aspect with considerable variations in depth, so well suited

to the production of fine crayon drawings. The grain, in both methods, serves the purpose of retaining an even film of moisture on the plate, thus rendering it easier to print from than when polished.

It has been stated that when zinc is calcined it is more "porous," and that if a special crystalline deposit be then made in the surface of the plate, it gives a fine bright surface equal to aluminium. Such treatment is said to prevent oxidation, and to greatly strengthen the affinity of transfer ink.

In 1910 it was stated than an alloy of one part zinc and two parts aluminium makes a plate of similar printing qualities to zinc and aluminium. It is known as "Alzene," and is supposed not to oxidize.

In 1891, Mr. G. E. Heyl, of Berlin, and Mr. G. H. Block, applied for a patent for an alloy of aluminium and zinc. But they found that the metals did not combine in any proportion, and that the various acids, etc., acted differently on the two metals.

Zincography, like lithography, means writing or engraving upon the substance. As early as 1805, H. W. Eberhard of Magdeburg used zinc as a means of etching blocks for relief printing. It was not long after that date that zinc was used for surface printing as a substitute for stone.

CHAPTER IV.

PRINTING FROM THE METALS.

At the outset it may be as well to lay down the important stipulation, that if anyone is to succeed in printing from the metals it is imperative that all ideas of printing from stone must be set aside. The metals must each be approached separately as a new or foreign surface. It is not intended by this to say that a printer's knowledge of the use of a roller, gum arabic, turpentine, transfer paper, the press and the machine is not to be applied to printing from metals. On the other hand such knowledge is invaluable, and must be brought into active assistance. But as soon as any re-agent has to be applied which exerts any chemical influence, then the difference between stone and each of the metals becomes apparent. The first three chapters of this work have purposely been devoted to the chemical aspect of the metals with a view to placing in the hands of the printer the reasons for all that is done, and to stimulate the workers upon metal to enquire further into the possibilities of printing from it.

The half-tone prints, executed from zinc and aluminium plates, are in themselves proof sufficient what excellent qualities these metals have for such work. It should be remembered that considering the large number of points in a small space, the necessity for printing with a stiff ink, and to obtain a brilliant impression, the speed of the machine must be slackened accordingly. The best quality of work should not be printed at the same speed as commoner work.

CHAPTER V.

GRINDING AND GRAINING PLATES.

In order that it may be dealt with systematically, this subject will be taken in sections. Whether using zinc or aluminium the plate must be grained. About the year 1880 it was understood that for transfers the zinc could be polished; but experience at that time was sufficiently negative to warrant the statement that both metals must be grained. The mechanical method of placing the plate in the bottom of a large flat trough or tray, sprinkling with very fine sand, ground glass, or pumice powder, then covering the entire surface with heavy "marbles"—usually little glass spheres—and fine sand, if a fine grain be required, or lighter wooden spheres with pumice powder if a coarser or flatter grain be required, or porcelain "marbles" if a coarse deep grain be required, and setting the tray in motion at about 150 revolutions per minute, has every possible recommendation.

In putting in the marbles it is best to cover the plate thickly with them, then add thirty or forty more to lie on the others at first, but ultimately to fall into spaces as they occur and complete the solidity and uniformity of the graining mechanism. After graining, the balls and the trough must be thoroughly washed out. This method was introduced about 1901 and its satisfactory results have induced its general adoption in all countries. It is only in houses where graining is seldom required that the hand method is likely to prevail. In the hand method, referring again to fifty years ago (1870–1880), a muller of stone was used to grain the metal, after it had been covered with sand, ground glass or pumice powder, and sprinkled with water. For some unknown reason it was replaced by a zinc muller. It may be that the stone used had been too large and did not go into the depressions of the plate; it may be that a smaller stone muller, which would dip into the hollows, was too light in weight and too small to handle over a large surface. Still, the zinc muller became recognised as the more suitable, and, perhaps, the most suitable form it

took was that of bending a piece of zinc over a large cork. In some Government offices, however, the muller was a solid zinc one. It is of little avail to argue that zinc is more suitable than stone as a muller, because it is zinc; for, at the present time, the most effective graining is done by small, light glass or wooden balls, or large porcelain "marbles."

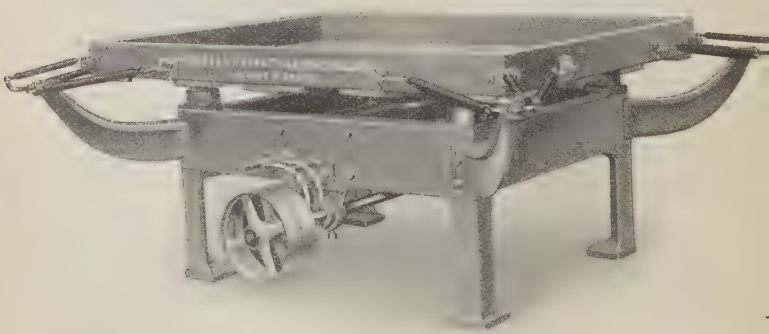
In manipulating the graining machine, whether manipulated by hand or driven by power, the same care is necessary as in graining stone. The sand must not be allowed to work down to a slime before it is renewed, or a flat grain will be the result.

To suit fine and coarse work, plates should be grained in several degrees of coarseness, from a very fine matt surface to an open, crumbly, rough grain.

The graining already described covers that part of the preparation which must be given to all aluminium or zinc plates. There are, however, other preparatory methods necessary prior to placing the aluminium or zinc in the grainer.

HORSELL'S NEW PATENT PLATE GRAINING MACHINE (Patent No. 240,603).

To those firms who are regularly graining their own plates, either zinc or aluminium, the new and considerably im-



PATENT PLATE GRAINING MACHINE.
FRANK HORSELL & CO., LTD.

proved type of plate graining machine recently introduced by Messrs. Frank Horsell & Co., Ltd. (Pat. No. 240,603) will be of considerable interest and decided advantage.

In this machine they have done away with the old type of double eccentric drive, with its attendant jolting or jerky movement, and the new machine is driven by a single central eccentric, fitted with ball bearings, and controlled by springs. This gives a perfectly easy and smooth running motion, and the absence of vibration and jolting is very noticeable.

Messrs. Horsell claim for this machine:—

1. Considerably less power required to drive.
2. Cost of repairs reduced to an absolute minimum.
3. Gives better and more regular graining.
4. Plates grained in a shorter time.
5. Perfectly smooth running.
6. Additional tank or tanks can be added over the existing tank, so as to increase the output considerably.

Messrs. Horsell are so well satisfied with the results to be obtained from this new type, that the whole of their new plate graining works are fitted with them and they continue to give the utmost satisfaction, and also to the various firms who have purchased this machine.

Graining machines are also made by Messrs. J. Greig and Sons, Hunters Ltd., A. W. Penrose & Co., Ltd., and others.

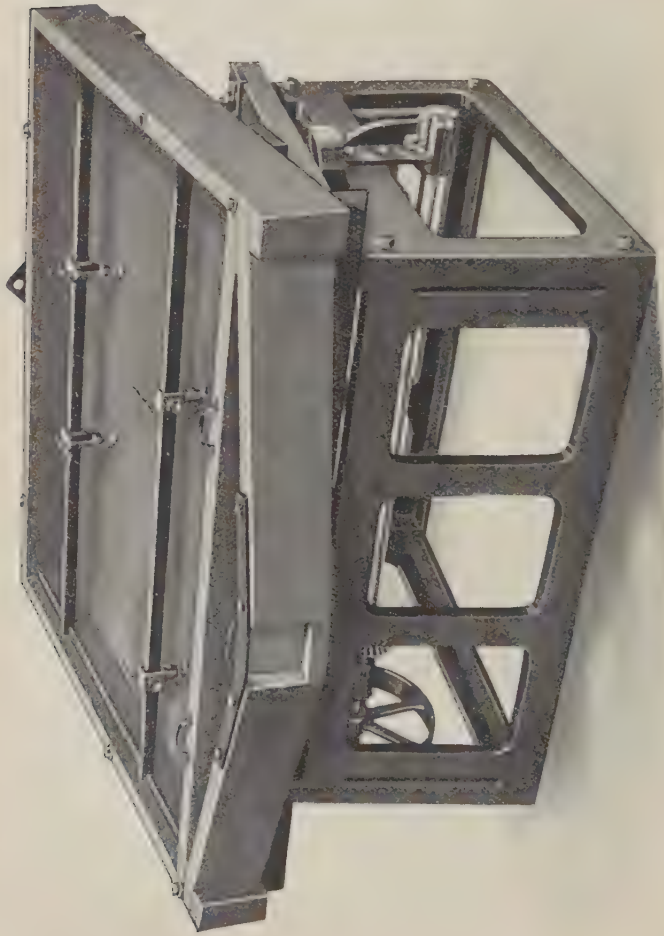
MCKINLEY AND CO., CINCINNATI.

This firm of printers' engineers makes two appliances of special interest. One is a plate graining machine with a box at one end, into which the graining balls can be rolled and washed, and ready for the next plate. The grained plate in the main trough can then be thoroughly washed and the water run off through the ball compartment by tilting the whole trough. The trough is lined with $\frac{1}{16}$ in. zinc, and the sides of the trough are protected from the balls by wooden strips $1\frac{1}{4}$ in. thick.

FUCHS AND LANG MANUFACTURING CO., NEW YORK.

Their plate graining machine is similar to that of Messrs. McKinley & Co., having a ball box and gate. The balls are run off into baskets for washing by immersion in troughs to let all the sand fall through.

These machines are made in three sizes for plates of 45 in. × 34 in., 59 in. × 42 in., and 65 in. × 48 in., requiring respectively, $\frac{1}{2}$, $\frac{3}{4}$ and 1 h.p.



Rutherford Plate Graining Machine.
The Fuchs & Lang Mfg. Co.

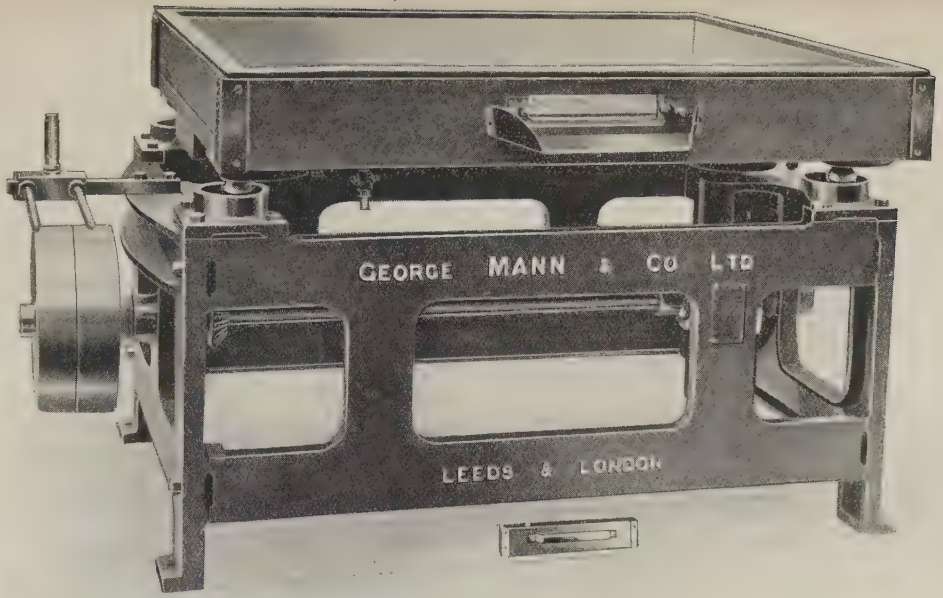


PLATE GRAINING MACHINE. GEORGE MANN & CO., LTD.

ALUMINIUM.

If new aluminium be used it must be placed in a bath of one-third nitric acid and two-thirds water. This bath can be kept, and will retain its necessary activity for some six months. It can be refreshed by adding more nitric acid; and if it become dirty or dusty, some sulphuric acid should be added and the scum taken off.

After the plate has been in the bath for six hours during warm weather or double that time in cold weather, it must be taken out, well rinsed under a good flow of water, and it can and should be roughly ground with pumice powder and a felt rubber. In operating upon plates, they must always be supported on large flat surfaces. It is well not to let the plates in the bath touch one another; nor to take more than one at a time from the bath, as standing aside damp does them no good.

In treating old plates with work on, the work must be cleaned off with turpentine, or petroleum with pumice powder and a felt pad, followed with a wash of benzine, then placed in the nitric acid bath, for the same time as new plates. The plates should come from the bath with a fine, soft, white

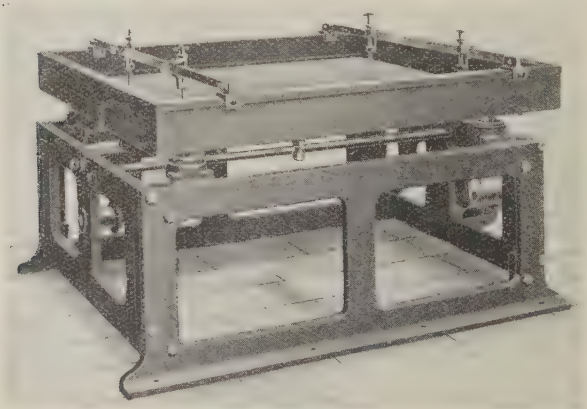


Plate Graining Machine.
Linotype & Machinery, Ltd.

appearance. Alum in the proportion of ½-lb. to each gallon of water may be added to this bath.

Instead of immersing the plate for so many hours in the nitric acid, alum and water bath, the plate may be cleared from old work by using the following solution:—

Nitric acid	6
Hydrofluosilicic acid ($H_2S_2F_6$)	10
Clean or distilled water	84

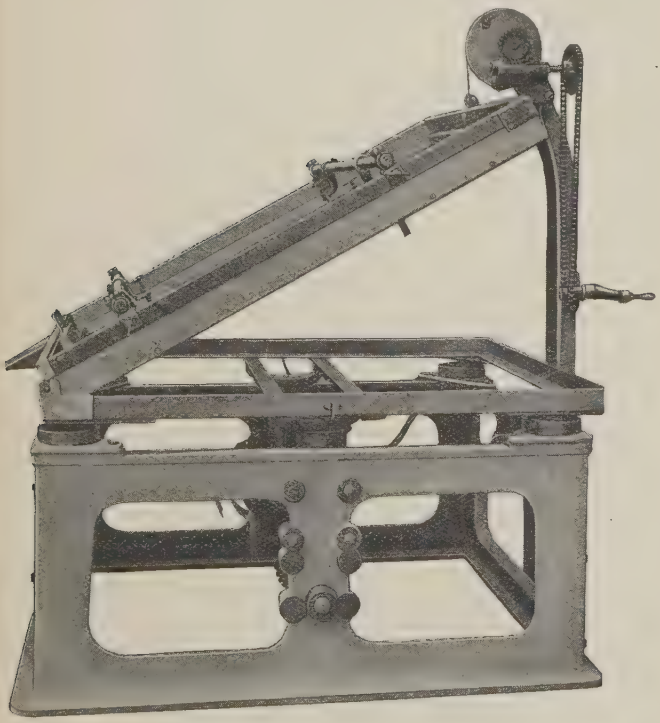


PLATE GRAINING MACHINE.
FRANCIS J. CONNOLLY, LTD.

and rubbing the plate well with pumice powder and felt pad with this solution on it. The plate must be well rinsed and regrained. The graining of such a plate should take about forty-five minutes. After graining, the plate must be well rinsed with a strong spray to clear out any powder, and dried quickly with an absolutely clean sponge, or clean, boiled, linen cloth, then dried rapidly by a fire.

The graining of aluminium has been the subject of various treatment. It was discovered at an early date that drawings upon aluminium did not seem to get hold of the metal, as on stone and zinc. There seemed to be a lack of chemical affinity. The same trouble exists at present, for, if the drawing crayon should be too hard, or too "long," owing to too much shellac in its composition, or to the want of proper burning to "shorten" the wax, it appears to catch on the grain and break off in isolated particles, which give the appearance of a good half-tone or three-quarter tint, yet in reality these particles only adhere at one end, and when etched and rolled up they are bodily removed, leaving only their point of attachment as the remains of their effect as a printing surface. There is little doubt that the best medium yet remains to be discovered for drawing upon aluminium. In the efforts already made to secure the proper chemical contact of the drawing material and the plate, mechanical, rather than chemical, methods have been adopted. The treatment which apparently received much favour, and was, undoubtedly, the method which gave printing from aluminium the greatest impetus, was that of rolling the plates after graining so as to produce a burr or somewhat flattened or mushroom top on the grain, introduced by Herr Christian Scholtz in 1897. By this means, possibly, the drawing crayon was held in position until the etch had its effect, and chemically fastened the grease to the plate.

After a satisfactory grain has been produced the plate must be well rinsed with a flow of water; dipped in the nitric acid bath; well rinsed again and dried quickly, preferably in front of a fire. It is then ready for drawing or transferring upon. It has already been stated that plates which are stored away, although well wrapped up, suffer a form of surface deterioration. It is slight oxidation and work will not go down on the plate satisfactorily. To obviate this, it is essential that every plate used by the printer must be freshened by scouring the

surface with pumice powder and a felt rubber before any work is put on. It is of no avail to think that every new plate purchased has been newly prepared, and it is safer to treat all alike. When the plates are actually re-prepared in the house, and are used at once, such a precaution is unnecessary.

ZINC.

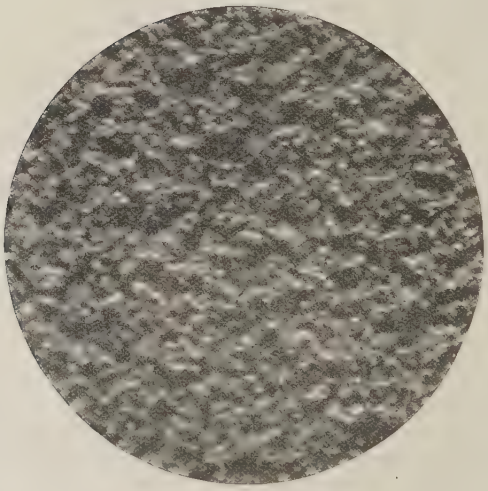
In the graining of zinc plates the nitric acid bath treatment is unnecessary. In the first place, if new polished or raw zinc plates are purchased, they should be well rolled through a press, placing pads of felt over any undulations to press them flat. Little dents in the plate may be hammered out with copperplate engravers' hammers, etc. Having obtained a good flat plate it should be well washed over with caustic soda solution. The plates may be grained after a good rinse, by hand or machine, and immediately rinsed under a flow of water, preferably hot, then dried quickly before a fire. If grained by hand, use sand sifted through a 150 or 160 sieve. Although zinc does not oxidize in air or damp, yet the moisture on the surface is a suitable vehicle and agent through which the carbon dioxide in the air may act. This acid gas converts the surface into zinc carbonate, and the carbonate effectually covers or plates the zinc, forming an impervious layer. Zinc kept absolutely dry is seldom affected in this way. The face of the plate with the work on must be kept thoroughly dry, and covered evenly with good gum and dried quickly, to prevent the action of the carbon dioxide of the air.

To re-prepare zinc plates which have had work upon them, the work is removed by washing with turpentine, followed by a wash with caustic soda—caustic soda, 1 lb.; water, $1\frac{1}{2}$ gallons. The caustic soda neutralizes the fatty compound of the ink with the zinc, then wash over with weak sulphuric acid to neutralize the caustic soda; after which it must be re-grained.

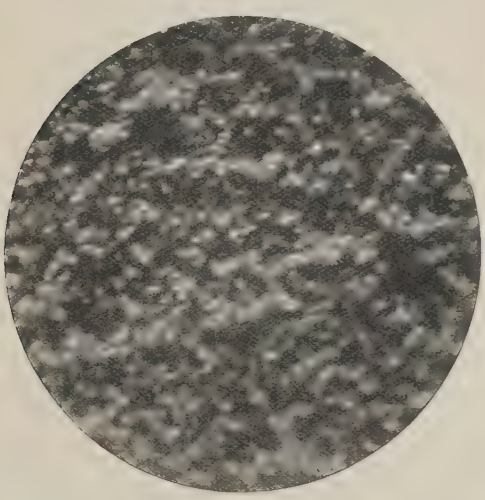
There is another method of preparing zinc plates which is simple and very effective. The work is washed off with turpentine, followed by caustic soda. The soda must be applied until all traces of the greasiness of the old work have been eradicated. Then make a solution of:—

Alum	5 ozs.
Boiling water	100 ozs.
Add nitric acid	1 oz. or even 2 ozs.

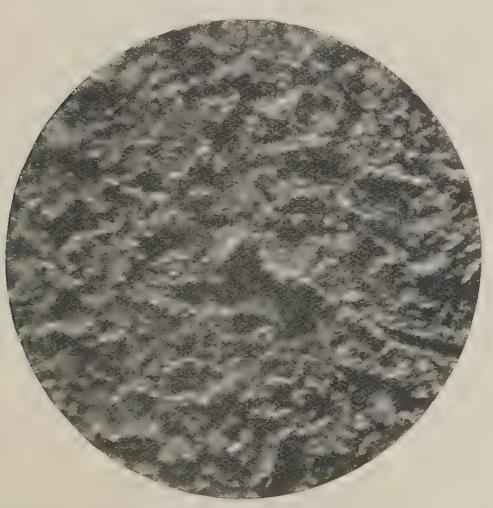
This solution may be flooded on the plate. It should be kept moving for two or three minutes over the plate until (by experience) it has done its work, then washed off with sponge and water and the plate dried quickly, when it is ready for use, providing the grain has not been worn off.



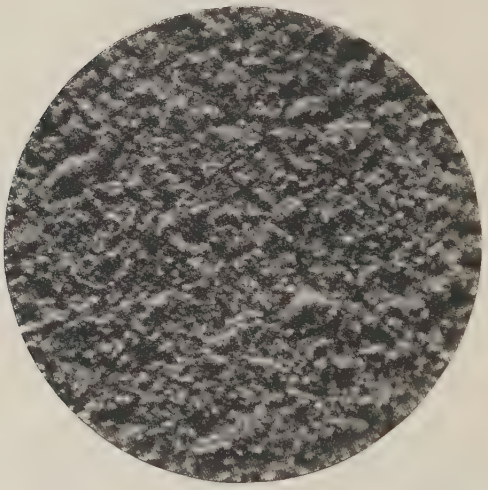
SANDBLAST FINE GRAINED ZINC, MAGNIFIED 60 TIMES.



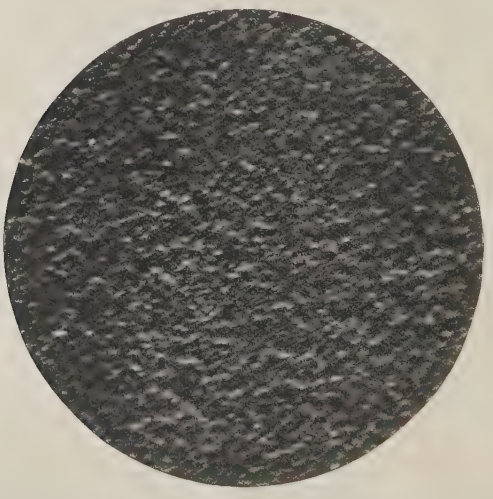
MACHINE FINE GRAINED ZINC, MAGNIFIED 250 TIMES.



MACHINE COARSE GRAINED ZINC, MAGNIFIED 60 TIMES.



Machine Fine Grained Aluminium, Magnified 60 times.



Machine Fine Grained Zinc, Magnified 60 times.

CHAPTER VI.

ZINC—TREATMENT IN THE PRESS.

HAVING treated upon the graining of metals in which there is in some respects a similarity, the two metals will be taken separately to prevent any parallel comparisons causing confusion.

New grained zinc plates should be rubbed all over with dry pumice powder and felt pad. Drawings can then be executed upon them in crayon alone, or ink and crayon, and transfers be run down upon them. In using crayons or ink, the soap and fat which they contain do not take so readily to the metal as they do to stone. To assist the chemical combination chemical means must be employed. Especially is this necessary in using crayon upon zinc, stone or aluminium, because the soap in the crayon must be decomposed and the resultant acid or acids unite with the printing surface to form an insoluble compound before any amount of water is used on the plate. The chemical change is effected by an etch or treatment with some acid which will act upon the soap. Upon stone, nitric or tannic acid may be used. For zinc, nitric acid must not be used, but gallic or chromic acid is available. This first etch may be prepared as follows:—

> Soak $1\frac{1}{4}$ oz. gall nuts in 1 pint of water; after 24 hours' soaking, boil the solution; allow to cool; strain off the nuts and dirt. The filtered solution contains the gallic acid.

To mix the etch use:—

Gall-nut solution	$\frac{3}{4}$ pint.
Gum solution, ordinary strength ...	$\frac{1}{4}$,,
Phosphoric acid	2 drachms.

This etch is brushed all over the plate with a flat camel hair brush and allowed to attack the ink for a few minutes. Finally wipe it off carefully and gum up the entire plate, which may then be allowed to dry. Another etch may be prepared by using a strong solution of tea, in the same

quantity and in place of the gall-nut solution, with the gum and phosphoric acid.

Of the made-up etches on the market the claims of "Zetch," as set forth in Chapter XIII, appear to make it the most useful for all kinds of work. For full particulars see Chapter XIII.

A good etch is that advised for use with the patent litho plate in 1885–6, consisting of potassium bichromate and gum. To prepare this, dissolve 1 oz. of potassium bichromate in 20 ozs. of water. Take, say, ¼ pint of this solution and mix with ¼ pint of gum solution of the ordinary strength.

Another form of this etch is apparently that supplied for the Parker plates. The etch is in two bottles: No. 1, probably phosphoric acid; No. 2, apparently a strong solution of potassium or other bichromate, or chromic acid. Of these, use 1 oz. of each in 16 ozs. of gum solution of ordinary strength.

In all cases the etch is to be laid on the work with a large flat brush, treated locally with more "etch" where necessary, roughly wiped off, gummed over and allowed to dry. If desirable the plate may be placed in a large dish, the etch poured in and rocked over the plate, as done with stone in the period 1840–50 and after.

The gum having dried, there are alternative ways of washing out. The gum must be left on the plate, and the actual work washed out on top of the dry gum with turpentine. This leaves the work bare and clean to receive the ink. Instead of turpentine, an effective washing-out liquid may be used. These liquids can be prepared as follows:—

> Place a quantity of crayon parings in a bottle large enough to hold 1½ pints of turpentine; add 1 pint of turpentine; shake up well and allow to stand. If the crayon parings are all dissolved, or nearly all dissolved, add more so that the solution may be a strong one. After some hours, best gauged by experience, strain off the liquid and add 1 oz. of sensitive bitumen or asphaltum. Shake up well and allow time to dissolve.

In houses where crayons are largely used this is the cheapest method of preparation, and the liquid produced is one of the best.

Another similar liquid may be made thus:—

Soak a quantity of good beeswax in 1 pint of turpentine until it is saturated; strain off the liquid and add one ounce of sensitive bitumen or asphaltum.

This liquid can be prepared by any printer. The sensitive bitumen can be obtained at any photo-process supply house.

Having washed out the drawing with either of these two last "doctors," the work has become so firm and so sound that it may be relied upon to print. In the older method, when the work was washed out with turpentine only and rolled in solid, it was customary to sprinkle with water and to continue to roll up until the work came out sharp. But such a method resulted in filling the roller with a mixture of gum and water and it was necessary to scrape and wash up afterwards. It is better and cleaner to take some clean rags, and bit by bit wipe off the gum and ink until the work is practically clear. When using a "doctor" for washing out it does not require rolling up solid, but can be washed off at once.

Having obtained a clear plate it is then necessary to roll up and etch, as is done with stone. If the potassium bichromate etch has been used, and the plate wiped clean, there will be very little cleaning up necessary. The potassium bichromate is most effective in killing all the scum and finger marks, as well as being an effective etch for the original drawing. It should be remembered that in getting the work "into" the zinc, there has been greater difficulty than with stone. The metallic soap formed is not so active as with stone, and it is more often the effect of the grained surface of the zinc, rather than a strong chemical affinity, which causes the zinc to catch bits of ink, grease or varnish on the surface. The second etching, therefore, should in some way affect the metal, either by wearing down the face a little smoother, or by glazing the surface to prevent, as far as possible, catching of the ink by the grain, and the formation of greasy spots. Of the etches in use there are three well known. The first is the gall-nut solution, gum and phosphoric acid, of about half the strength of that used for etching original drawings. The second is virtually the same, only that it can be made up from prepared gallic acid. It is a mixture of:—

Gallic acid	1 oz.
Phosphoric acid	½ ,,
Gum solution	1½ pints.

In this case the quantities given are not limited, and may be altered within reason.

But in both these cases the nullifying effect on the zinc surface is not of long duration. It requires frequent repetition to keep a clean plate. The third etch is a reminder of the attempt made years ago to secure a glazing of the surface by treating with potassium oxalate solution.

This etch is made up of:—

Ammonium silico-fluoride... ... 1 oz.
Ammonium nitrate ... ... 1 ,,
Dissolved in hot water, 24 ozs.

This etch no doubt attacks the zinc and for a time forms an effectual non-metallic glaze on the surface.

"Zetch" is effective as the second etch as well as for the first etch.

The second etch having been completed the plate is ready for use. It may be added that both for the first etch and the second etch one solution may effectively be used, varying the strength as required, viz:—

Gum solution ... ... 1 pint.
Phosphoric acid ... ... ½ oz.

For the first etch the strength may be phosphoric acid ½ oz. to gum solution 20 ozs., and the second etch phosphoric acid ½ oz. to gum solution 15 ozs.

In all cases where gum is used, one or two drops of carbolic acid (Calvert's No. 2) should be added to each pint of gum to keep it from turning acid.

Having obtained good sound work on the plate, it may require cleaning. The spots of grease amongst the work are most effectively removed by treating with solution of caustic soda, using wooden stumps or quill. Scraper or polishing stone should not be used. Large areas of dirt may be removed by turpentine and the phosphoric acid (1 oz.) and gum (1 pint) solution. In fact this solution is effectual in keeping down scum. The potassium bichromate and gum solution used for the first etch is perhaps even better for keeping down scum both on zinc and stone, if it be allowed to remain on a minute or two and then washed off.

In rolling up for proving, and in machine work, there is no solution so effective as strong tea for keeping the plate clean. When the edges of the plate become smooth, it is best to

roughen them with coarse glass or sand paper, and treat them with the etch as used for machine purposes, see Chapter VIII. Scumming may be also removed by weak acetic acid, and this treatment also freshens the surface of the zinc, giving it a brighter appearance. But acetic acid, sulphuric acid, or the mixture of alum water and nitric acid, all have a tendency to thicken the work.

Amongst the recent additions to the chemicals used for retaining upon zinc a hygroscopic layer, is the molybdate of soda. A weak solution of this salt proves very effective in printing to keep down scumming.

In the earlier days of zincography it was generally considered that, in printing in colours, the various metallic, non-metallic and organic pigments were affected in colour by contact with the zinc. This may have been so when less pure zinc was used, or before phosphoric acid was introduced into the etches. But since about 1880 this matter has not been seriously taken into account. The pigments are so well ground into varnish that every particle is practically surrounded by a film of varnish and never comes in contact with the zinc. However, the use of the potassium bichromate and gum etch, and subsequently the treatment with the ammonium silico-fluoride solution, have made zincography as simple and as easy as working from stone.

Ordinary lead pencil should not be used for marking the lay, etc., on zinc, as it takes ink. In its place use a thin silver coin, or have a piece of silver wire mounted like the lead in a pencil.

CHAPTER VII.

ZINC—TREATMENT IN THE PRESS.

TRANSFERS, SET-OFFS, TRANSPOSITION, ALTERATIONS AND ADDITIONS.

TRANSFERS for zinc should always be pulled a little fuller than for stone. They may be put down upon either dry or damp plate. If the paper must be damped, the stone supporting the zinc may be warmed to impart a little warmth to the plate. By using ever-damp transfer paper, much trouble is saved. It is unnecessary to moisten the plate with turpentine before putting a transfer down. Such a course may be resorted to for very old dried transfers. But if there is any doubt as to the freshness of the plate, or the weakness of the transfer, it is advisable to treat the plate with the solution of water (1 quart), alum (1 oz.) and nitric acid ($\frac{1}{4}$ oz.), which makes it highly sensitive. Many excellent transfers have been secured by this treatment.

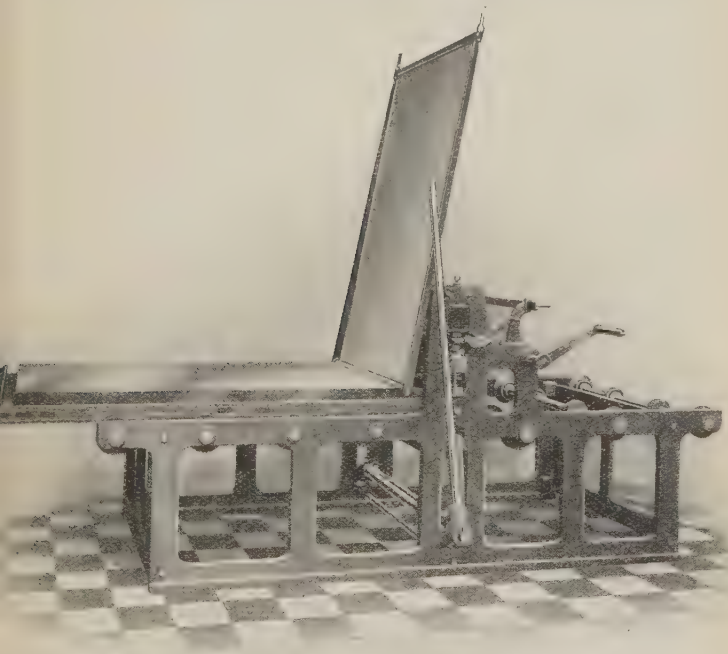
Transfers of all kinds can be put down to zinc. Copperplate, lithographic writings, autographs and crayon work are all equally suitable.

The difference between treating a transfer and an original is to omit the first etch. The method is to gum up, allow to dry, and wash out the work on the dry gum with a "doctor" or washing out liquid. The etch used subsequently should be the gallic acid (1 oz.), phosphoric acid ($\frac{1}{2}$ oz.) and gum solution ($1\frac{1}{2}$ pints). (Recipe No. 30) or "Zetch."

In putting down transfers, especially from copperplate, it frequently happens that a large amount of scum is present. This is only a surface film, and if carefully treated with an etch and a sponge or tuft of cotton wool, is effectively removed. Whiting, or other fine absorbing dust, may be used in the same way. Even though the actual work is rubbed at the same time, if due care be taken the work is not appreciably affected.

ALTERATIONS AND ADDITIONS.

In order that alterations or additions may be made on zinc plates, the plate must be cleaned. If an addition only is to be made, the plate may be cleaned after washing off the gum



LITHOGRAPHIC TRANSFER PRESS. LINOTYPE & MACHINERY, LTD.

with a solution of nitric-acid-alum-water, used carefully and expeditiously. Acetic acid is almost as effective. The plate is then perfectly clean and ready to draw or transfer upon. Newly drawn work may be rubbed off the plate with india-rubber or ink eraser; but always turn clean surfaces of the rubber to the work, and do not rub the grain flat.

In cases where small work has to be removed, the grease is eradicated by treatment with caustic soda over the work on the dry gum, washed and re-prepared with either the alum solution or alum, water and nitric acid solution.

In all cases the cleaning of zinc after the alum, or acid-alum water, before drawing or transferring upon, is best done by scraping pure chalk or whiting on the plate, sprinkling with water, and gently rubbing on the plate for a few minutes, then washing off with clean water. Treating the plate with acetic or sulphuric acid, or the alum, water and nitric acid mixture as indicated above, are liable to thicken the work, if not followed by the whiting to neutralize the acids.

Benzine is one of the strongest solvents of grease in the plate. It may be used instead of turpentine. The frequent failures in taking work out of the plate are due to hurriedly putting on the caustic soda, and washing it off before it has neutralized the work, which is a fatty acid compound with the metal.

TRANSPOSING.

Transposing upon zinc can effectively be done by drawing the work with Indian ink and gum. When dry, cover with "doctor," and treat as for original work. The work may be drawn with a medium of silicate of soda, and any ink. When dry, cover with "doctor," as above. This method possibly gives the best results.

When work already existing has to be transposed it must not be attempted on the same plate. A new plate may be covered with a thin film of L-AN-B or Zetch and dried. The film should be evenly spread and kept very thin. An impression of the work should then be run down on the plate. Such impressions may be in transfer ink. The work on the plate should be rolled up and well dusted and thoroughly covered with talc. The plate may then be cleaned with alum solution, or alum, nitric acid and water. When clean and dry, cover with litho draughtsman's ink, mixed thick, and treat as original work. The L-AN-B or Zetch under the impression will ultimately dissolve and the work will come away quite clean. But the manipulation takes much longer, and is not so certain in its results as when done on stone with potassium oxalate. It is, however, a better procedure to make the transposition on stone first, and

transfer it to zinc, instead of attempting to make a transposition directly on zinc.

A method of transposing, perfected early in 1911, can be recommended as most efficient. A transfer is put down on a clean plate and rolled up in the usual way. Then roll up full and dust with talc. If the work does not appear to be built up sufficiently, it may be further rolled up and again dusted. Cover the dry plate with shellac varnish, and dry. Wash out the transfer with turpentine; but do not rub forcibly as it may partially dissolve the shellac. Etch with the phosphoric acid etch (Recipe 44), to kill the original transfer. Wash off, dry, gum in well and dry. Wash off and roll up the plate, when it will be found that the shellac will take the ink where the white of the original was. Dust with talc. Etch with Recipe No. 44, and after rolling and washing out, a complete transposition will be effected.

SET-OFFS.

Set-offs upon zinc can be put down with a mixture of red chalk and a small amount of vegetable black, using a light brown glazed paper, or steel blue or flint paper.

The set-off may be made more permanent by using a mixture of:—

Aniline mauve	...	...	...	...	5
Magnesia	...	...	...	...	5

They can be run down on a slightly damp plate, or, if care be taken, the plate may be moistened with turpentine and a few drops of carbolic acid. This will give a permanent set-off.

It is necessary for red chalk set-offs that the zinc be damped with turpentine before running them down.

A method of putting down set-offs which scarcely recommends itself is to damp the plate with turpentine and run it through with clean paper, then put down an impression from the key in coloured aniline ink on plate moistened with methylated spirit, when the aniline colour will alone become the set-off.

There are now several set-off powders manufactured which give good results. See Recipes 66, 67. One of the most perfect of these powders is prepared by Mr. J. Crawford.

CHAPTER VIII.

PRINTING FROM ZINC.

THERE is very little to add to the previous chapters in dealing with the actual printing from zinc. When the presswork has been mastered the same principles must be applied.

Although in the first place it is difficult to get the work well established in zinc, yet when once there it remains good, and the mechanical character of the grain tends to accumulate scum. In the mixing of the ink it must be thoroughly well ground, and the necessities of chromo printing require that tints must be used with thin varnish. The varnish has a strong tendency to cling to the plate. If the etch has been by potassium bichromate and gum, and after rolling up, the plate has been treated with ammonium silico-fluoride mixture, very little trouble should arise. An occasional treatment with the latter solution will continue to keep the plate clean. If this be not used then tea solution must be regularly used for damping. Even a watery solution of golden syrup will act almost as well. If under any such treatment scum should appear it can be removed by acetic acid, or, if necessary, caustic soda followed by an etch and gumming up.

The most important point in printing from zinc is mounting the zinc properly on a stone or bed plate. In a press the zinc will remain steady upon a damp stone, or a sheet of thin damp paper may be placed on the stone and the zinc laid upon it. In the machine the means of mounting must be more certain. In many houses zinc is mounted over a stone, being bent down the front and back edges and held by the blocks in the carriage. It may be simply bent with a slight incline and nailed to the blocks, or it may be bent down and fastened by the blocks against the stone at the gripper edge, the front edge being only bent down with a small incline so that it does not rise in the forward movement. When using a stone, place a layer of waterproof elastic bedding

flannel under the plate. It is better, however, to use the iron bed plates now so commonly employed. The improvements in these bed plates leave little to be desired. Bed plates are made with one long gripper on one side, which holds the plate to the bed, and a long double gripper at the other side into which the other edge of the plate can be clamped, prior to forcing it away from the bed by screws, thus drawing it tightly over the bed. This movable gripper may be made with only a slightly inclined jaw to take thick plates without much bending. Another variation of these clamps or grippers is to have them divided into two, three, four or five small clamps so that the plate is gripped only at intervals. This is applicable to all plates, and is especially useful when the edges of the plates are somewhat wavy. In mounting plates on stone or bed plate the surfaces underneath in contact must be scrupulously clean; the smallest grain of sand or fabric will ultimately raise a point in the plate. See Chap. XIII.

Before actually commencing to print run the machine with clean paper, and get the plate stretched and settled in position, then tighten up the locking and stretching nuts. At any time when printing is stopped for an interval always gum it up thinly.

For long runs of fine work zinc may be etched into low relief, in a similar manner to stone. A strong "rosin etch" is given, using an etch of nitric acid 1 part, water 30 parts. The rosin may be melted into the ink with moderate heat. In this respect zinc is much more suitable than aluminium.

A writer in *Allgemeiner Anzeiger für Druckerein*, in 1906, states that when zinc plates have been scoured with acetic acid, and the etch used has been saturated alum 25, thick gum 75, nitric acid 3 to 5, they not only give a good water absorbing surface, but the plates do not oxidize.

PRESERVATION AND STORAGE.

Zinc plates have been so long in use that the following three methods of preserving them need be but briefly outlined. The work on the plate should be rolled up in good transfer ink, dusted with talc, or better still with the transfer preserving dust obtainable from sundrymen, then gummed up evenly with good gum arabic solution containing a few drops of carbolic acid (Calvert's No. 2) and dried. When dry they should be stored in pigeon holes in wooden cupboards and

kept dry. They may be perforated and hung on long nails; so long as they hang loosely with a free circulation of air they remain good; or if they are originals they should be kept in wrappers, as copperplates are kept.

Although many firms have methods for storing plates with work on, for future use in repeat orders, it seldom occurs that any method is of the ideal character. There is little doubt that to keep plates properly, both for protection against injury and for indexing they should hang separately. These conditions are insured by using a simple rack, recently patented (1926, No. 18,302) by Mr. W. P. Price.

The average size of rack is 35 in. long by 20 in. wide, to hang twenty-five double crown plates. The woodwork is a series of sliding bars, running in grooves. These are mounted on a light frame, having two battens across, through which the frame can be screwed to ceiling joists. It is, therefore, well up, out of the way, and can be put up all round the room. There are no long wooden sides to come down to the floor and interfere with benches and machines. Each plate has three holes punched at one edge, by which it is hung on three pegs on a slide bar. This bar fits into a groove in the frame and can be put in and taken out without touching or scratching any other plate.

Each plate has its own slide bar: each bar is numbered and the plate is numbered to correspond. The plate index is kept in a book, and it is very easy to find and draw out any plate required. There has not been any form of storage so simple and effective before. Not only does it make storage easy, but as each plate hangs separately, there is a constant circulation of air over each face of the plate. This rack is obtainable from Algraphy Ltd.

The use of zinc plates for originals cannot be too highly recommended. They will apparently withstand much rough usage, providing they do not get wet or come in contact with damp metals. When plates thus put away are required they will usually roll up without much trouble. If there is any difficulty in washing it out, it is necessary to cover the plate with turpentine and sprinkle on a few drops of carbolic acid (Calvert's No. 5), or Izal oil or Cresylic acid, which will almost instantly commence to dissolve the old ink. After rolling up and as soon as the plate is in a fit state to manipulate treat it with the potassium bichromate and gum etch, followed

by a good rolling up and, if necessary, a final treatment with etch before printing.

Zinc plates may be treated as aluminium plates are, by rolling up well, drying quickly, gumming thinly and drying well. Then wash out with a "doctor" and leave the film all over the plate. In some cases this method is carried a little further by washing off the gum and film of "doctor," drying the plate thoroughly and again gumming up evenly. The plate should be dried quickly after the last gumming up.

When such plates are required for use they should be re-gummed before washing out with "doctor." If the old dry ink still refuses to be dissolved, it must be gently removed by treating with turpentine containing a few drops of Calvert's carbolic acid, No. 5, or Izal oil, or Cresylic acid. On no account attempt to remove the ink by harsh measures, such as the use of salt; no abrasion should be necessary if turpentine and carbolic acid be used. Work of at least ten years' standing readily surrenders to this treatment.

To preserve zinc plates with work upon them, there is another method recommended, to gum up upon the clean dry plate with gum and potassium bichromate (5% sol.). Of the latter add only a little. When "gummed," fan dry and expose to light to harden for about half-an-hour; finally gum over with new pure gum solution containing a few drops of carbolic acid, No. 2. When required for use, dissolve the gum layers with water containing 1 to 2% phosphoric acid. But such a method is a doubtful one and should only be used when the store room is unavoidably damp.

CHAPTER IX.

ALUMINIUM—TREATMENT IN THE PRESS.

THE treatment in general bears several similarities with zinc, but the two metals differ in their chemical affinities and must be treated accordingly. All plates must be scoured with pumice powder and felt pad before drawing or transferring on them.

There is perhaps no drawback in the use of aluminium so great as its rapid deterioration or oxidation in air, and especially under the slightest traces of water. A plate once oxidized is scarcely fit for anything except re-graining. To prevent oxidation when using water or gum under any circumstances during processes which terminate in drying, always dry quickly, either by rapid fanning or in front of a fire. In the machine work, at every stoppage raise the dampers, so that they cannot touch the plate, gum up the plate and dry it quickly. Unless this is done an insensible scum will arise all over the plate, gradually becoming visible and ultimately darkening the plate and the print practically beyond remedy. If the scumming be noticed in its very early stages it may be checked with the strong etch—gum water 30, and phosphoric acid 1—rubbed on with felt dabber. In extreme cases the etch may be reinforced by using pumice powder. But such strong measures must be used with the lightest hand manipulation, for there is nothing more detrimental to aluminium than scratches. It is for this reason that scrapers should never be used for effacing work on aluminium.

Original work on aluminium, whether a drawing in ink or crayon, must be etched as with zinc, but the work must be well dusted with talc before etching. This first etch for originals consists of:—

Gum solution	12
20% sol. phosphoric acid	1
or	
Gum water (15° Baumé)	70
Syrupy phos. acid (45° B.)	1

To assist this action the plate may be warmed before dusting with talc. The etch may be laid on with a fine flat brush, or a sufficient quantity may be placed on the margin of the plate and spread over it with a soft sponge. Local etching should be done with a small brush. The etching being completed, the surplus may be taken off with the sponge. Finally it should be wiped all over with a gum sponge and dried, the drying being assisted by heat.

The gum having dried, the whole of the work must be washed out on top of the dry gum with a "doctor" or washing-out fluid, prepared as shown in Chapter VI, Recipe 50 or 51. After it has been allowed to evaporate, wash off the gum, roll up in black ink, dust with talc.

Instead of using the above etch the operation is rendered easier by the application of Zetch, which is a concentrated etch that is diluted with 1 gall. of water (warm or cold) to 4 ozs. of the Zetch powder. In use there is no need whatever to add solution of gum arabic; but if the gum be added it will do no harm. In use, the plate is to be gummed evenly and thinly and dried. On the dry gum wash out with a strong bituminous fluid or "doctor" with a dry rag—kept for that purpose only—leaving just a thin film on the plate. Allow it to dry. Wash off the gum and proceed to roll up in a good black, to ensure sharpness and solidity. Dry the plate, dust over with talc (French chalk) and clean up with quill or stump and solution of caustic potash. After which, wash the plate and apply the Zetch (first etch) with a sponge or soft pad of flannel. After two minutes' etching, wash off, dry, and gum up thinly and evenly. The plate may then be proved. Before printing in the machine, clean off the gum, roll up well, dust with talc and sponge over with the second or final etch of Zetch, 8 ozs. to 1 gall. of water.

When the work is of a fine character or consists of re-transfers, it is better to omit the washing out with turps. and the application of a "doctor," but rather to roll up well, dust with talc, clean up, and apply the Zetch first etch, and continue as above.

If the Zetch method be not adopted then clean the plate by first removing as much dirt as possible by india-rubber.

Strong spots or lines can be removed with a mixture of caustic soda and water applied with a quill, just as the acid

stump is used on stone, following at once with the gum sponge, and squeezing the caustic soda out of the sponge frequently;

or

Terra di Siena	1
Oxalic acid	2

or Sulphuric acid

dissolved and mixed in sufficient water to make a strong solution. This is applied with a brush or quill. Having cleaned the plate, etch with:—

Gum solution	8
20% sol. phosphoric acid	1

or

Gum solution (10° to 15° Baumé) ...	30
Syrupy phos. acid (45° B.)...	1

Sponge the etch well over the plate and keep the film of etch thin. Soak it up with the sponge and finally gum up with pure gum, using a sponge and leaving only a thin film. To ensure that the gum is thin, wipe the plate with a cloth damped with clean water. The gum having dried, it is ready for proving. The gum is washed off, the work washed out with turpentine, and rolled up in the necessary ink. In working upon aluminium plates the greatest care must be exercised in using sponges and cloths quite free from grit—the softest sponges being used with the coarser grained plates and swan's skin, or swan-down or molleton for the smoother plates.

In rolling up, the ink for each impression must be as fresh as possible; for this purpose large rollers should be used, and the slab frequently cleared of any dirty ink. Spots of water which have dried must be gummed over and removed with the transfer etch of gum 8, phos. acid 1, or the gum 30 and phosphoric acid 1. (Recipes 33, 34.)

In printing from aluminium the printing ink should be kept as stiff as possible; if the ink be a tint, the addition of a little magnesium carbonate, silicate of soda, even glycerine or gum arabic, will tend to stiffen the ink and prevent scumming.

CHAPTER X.

ALUMINIUM—TREATMENT IN THE PRESS.

TRANSFERS.

TRANSFERS for aluminium must be pulled in a good strong ink, and a little fuller than for stone. They can be put down to either dry or damp plates. In all cases the plates must be scoured with pumice powder and felt pad before transferring. It is doubtful whether aluminium should not always be treated with some alkaline wash before work is put upon it. It should be remembered that alum has properties in some respects similar to soap. They each apparently dissolve the greasy inks used in lithography, and certainly have results opposed to the sharpness of the work. So that aluminium with a compound of fatty acid and alkali may form a species of soap of the same peculiar insoluble kind as the oleomargarate of lime formed by fatty acid with the alkaline metal calcium of lithographic stone. But if that be so the acid action most probably proceeds from the aluminium, and combines with the alkali of the soap used in the crayon and ink. It has already been shown in Chapter II that aluminium will form compounds with the alkalis; and that both potassium aluminate ($Al_2K_2O_4$) and sodium aluminate ($Al_2Na_2O_4$) are known to chemists. As such compounds do occur, there is no reason why, in the case of soapy crayon or ink being applied to aluminium, the subsequent etch should not break up the soap, and in that action separate the alkali in such a nascent condition that it forms an aluminate of either sodium or potassium, or both, according to the nature of the soap used. These inferences give strong support to the suggestion that before a transfer is put down the plate is more active if washed over with ammonia solution. This is not only a suggestion, for it has been put into practice and found satisfactory. It is not uncommon to smear a stone with turpentine before transferring on it. The idea is to quicken the activity of the grease by minutely separating its particles and to some extent

this analogy bears upon the treatment of aluminium with an alkali. The alkali more or less separates the fatty acid and alkali in the crayon or ink, and, whilst partially combining with the fatty acid, liberates the alkali to form the aluminate with the plate. This treatment having been partially adopted in actual practice, it should be experimented with, and may ultimately prove of considerable value in alumenography.

If no alkali wash be first given to the plate, then every care must be exercised in getting down a good transfer. The use of partially damp paper and a dry plate is most effective, but when the composition is naturally hard by the presence of gelatine, it is necessary to damp the plate. It must always be remembered that too much water on the plate frequently prevents a transfer going down; hence has arisen the suggestion to use an alkaline solution for the damping. In running down a transfer it is advisable to use some six or eight backing sheets. It is strongly recommended that in all transfer ink used for aluminium plates a small amount of carbolic acid in the form of Calvert's Carbolic No. 5, or Izal oil, or Cresylic acid, should be added. The transfer ink itself should be mixed with a larger quantity of printing ink than used for lithographic work. The transfer having been run down as in lithography, it should be damped off with warm water, well rinsed until quite clean, and fanned dry quickly. At this stage, the plate being quite clean, any drawing with crayon or ink may be made.

If new drawing has been added, the plate is gummed up and fanned dry. The film of gum must be thin. The plate can then be put aside for a day or so, much to its advantage. In fact it is advisable never to hurry plates from the press to the machine. The plate is next washed out on the dry gum with "doctor," which is allowed to evaporate. Proceed to clean off the gum with water until the work is clear, roll up well, dust with talc, then etch with:—

Gum solution	12
20% sol. phosphoric acid	1

using a sponge and executing the etch quickly. Having again gummed up the plate and dried it quickly, wash out with turpentine, roll up the work well in an ink containing transfer ink, and if it fail to come up properly as a whole, rub

it up carefully. If only a few lines here and there show weakness, they may be firmly drawn upon with a hard lead pencil—6 H—and subsequently brought up by dabbing with ink on the finger; then dust with talc. The cleaning away of dirt may be done with india-rubber, or pumice powder and felt stump. The greasy spots should be removed with caustic soda solution and a quill as already described in the last chapter. If parts of work or large masses of dirt require removing, use concentrated sulphuric acid with a glass brush on the dry plate. Both sulphuric and oxalic acids are useful for cleaning away greasy dirt. When quite clear, give an etch with:—

Gum solution	8
20% sol. phosphoric acid	1

or

Gum water (10° to 12° Baumé)	70
Syrupy phos. acid (45° B.)...	1

The etch should be sponged over quickly, well washed off and the plate quickly dried; finally, gum up thinly and proceed to prove by washing out with turpentine, or a weak "doctor," on the dry gum, wash off with water, and roll up in the desired colour or black for machine or press.

The treatment so far concerns transfers taken from plate or stone from work already existing. But for transferring original drawings upon transfer paper a few details must be dealt with. Good transfer paper should be used with either gelatine or commoner glue or starch in the composition. But in all cases it is advisable to damp the transfer in the damp book until the ink looks shiny, then put it down to plate—a warm plate being advisable. The transfer ink used should be good or freshly mixed, and it will most probably be unsatisfactory to attempt to put down an old transfer. In damping transfers to assist the ink, the damping must be continued until the ink appears shiny. This may necessitate long damping, and, when that is the case, the transfer must be laid out a little while to dry somewhat before it is put down to the plate. Any attempt to put down an old transfer must be done on a warm plate. To transfer autograph writings the ink must be good and not too old. The aluminium plate should be placed on a warm stone. The "writing" must be carefully damped in the damp book, and no excess of moisture should appear. If the plate has not been treated

with carbonate of soda and water, it may be washed over with sulphate of aluminium. A backing sheet just barely moistened with turpentine may be laid on the writing when transferring. When transferred, treat as a transfer to aluminium as already described. When "autograph" transfers are to be put down it is advisable to cut out a few holes through the paper at blank spaces, then when it is laid on the turpentined plate, place on top a sheet of damped transfer paper as the first backing sheet, thus causing the paper to adhere and allowing it to be run through several times.

Having used plenty of backing sheets, with all the necessary back-damping, the transfers will generally peel off in a semi-dry state. If more soaking off be necessary use slightly warm water. When all the paper and composition have been cleared off, fan dry quickly, gum thinly, and dry. At this stage slight additions and even strengthening of lines may be done by drawing through the gum with a 6 H (hard) lead pencil, so as to expose the aluminium. These lines may even be scratched with a steel point or pen, and in either case a little good printing ink may be dabbed in to make them firm. As this is a transfer of new ink work it may be washed out with a "doctor," which must be allowed to evaporate, then wash off with water, roll up well, dust with talc, and etch with:—

Gum water (Baumé 10° to 12°)	70
Syrupy phosphoric acid (Baumé 45°) ...	1

followed by clearing off the etch with a gummy sponge, then gum up thinly with the gum sponge, wipe off thinly and fan dry quickly. The work may now be rolled up, after washing out with turpentine, and proved, the plate being cleaned as already suggested.

In transferring of all kinds there are many essential points which may be shortly enumerated as follows:—

Use anti-damp or ever-damp transfer paper as often as practicable.

When coated transfer papers are used, moisten the plate thinly and evenly, just before putting the transfer down, with an alkaline solution of:—

Bicarbonate of soda	1
Pure water	30

This must be put on the plate with perfectly clean linen rags, which have been boiled for five or six hours in two or three changes of clean water, and dried in a dust-proof room.

The temperature of the room should not be less than 70° F.

Transfer ink should be stiff. For drawings on paper it should be mixed thick. For pulling transfers it should be composed of half good transfer ink and half good printing black ink and worked stiff.

The grain of the plate must be suitable to the quantity of ink required for printing, and accordingly commensurate to the damping, the fine work on a fine-grained plate, and heavy work on a coarser grain.

Transfers must not be too bare, nor must they be too greasy. Old transfers require special care in damping in the book, and drying a little afterwards before putting them down.

Too much water on the plate, or in the transfer after damping in the book, will cause broken lines.

Dirty or greasy rags; excess of alkaline solution; and the old work on the plate coming back will all give scum.

When rolling up for an etch it must be rolled up full, then dusted with rosin and talc before applying the etch; the etch should not remain on the plate longer than it is allowed on stone.

The excessive use of the "doctor," with careless treatment, results in scum arising.

USE OF METALS FOR HALF-TONE WORK.

Finely grained aluminium or zinc are more suitable for half-tone transfers than litho stone. The difficulties arise in obtaining clean, sharp transfers from the block, and in the correct transfer paper to use. It is stated by Herr B. Enders, that the best transfer papers are the Berlin; and there are special papers sold by Algraphy Ltd., Tom Broad, Paul Fischer, Gilby & Herrmann, F. Horsell & Co., Hunters Ltd., F. Jenkins, G. McIntosh, A. Penrose & Co., B. Winstone and Sons.

In pulling the transfer, roll the block thinly, lay the transfer paper carefully, use a soft overlay and a thin glazed overlay;

pull through smartly without interruption. The transfer ink should be made of chalk ink 4 parts, transfer fat (stearin or wax) 1 part, and a little thin varnish. When the transfer is put down use a good firm backing, either well-rolled card, or card mounted on zinc. Before putting down a transfer on aluminium give the plate a wash with weak oxalic acid, or bicarbonate of soda, and finish with a good rinse of water. For zinc give a wash with nitric acid-alum-water. When the transfer is run down and the paper removed, gum up evenly; dry, wash off gum and roll up with nap roller; dust with talc, etch and gum up. Special care must be taken to get this layer of gum thin and smooth. This method is adopted for half-tone transfers because the amount of ink from the transfer is so small, and is liable to be partially glazed over by gum. Wash out with "doctor," clean off gum and surplus ink, and roll up sparingly with a nap roller, dust with talc, and give a weak etch. Finally, roll up and give a strong etch or treatment with L-AN-B, as already described—No. 1 for zinc, No. 3 for aluminium—or with Zetch. The printing should be on damped paper or on crayon printing paper, or on enamelled paper. The ink must be kept stiff and sparing.

CHAPTER XI.

ALUMINIUM—TREATMENT IN THE PRESS.

ALTERATIONS AND ADDITIONS, SET-OFFS, TRANSPOSITIONS, STORAGE.

ALTERATIONS AND ADDITIONS.

To make additions of a rough or minor character, such as strengthening weak lines, or adding a strong line or dot here and there, the simplest procedure is to gum the plate thinly, dry quickly, and then cut through the gum with a 6 H lead pencil so as to bare the metal. Into these scratches rub some good printing ink, or mixture of half transfer and half printing inks, or the "doctor."

In all cases when alterations and additions are to be made, the rolling up of the work must be done with a good stiff ink. Then it must be well dusted with talc. There are various methods of cleaning the plate thus left bare. It being well known that nitric acid decomposes gum, and virtually destroys it as gum, it is advisable to treat the plate with a 2 per cent. solution in water to free the surface from gum. But as the work and the plate have previously been treated with gum and phosphoric acid, thereby forming a salt of the metal which adheres to the surface, a solution must be used to decompose that salt. The mixture is composed of:

Saturated sol. of oxalic acid	4
Pure nitric or conc. sulphuric acid ...	4
Distilled water	90

A better form is to saturate concentrated sulphuric acid with oxalic acid and add water (acids 1 to water 9). This solution must be applied with a soft pad or a fine glass brush carefully on those parts to be re-prepared; it is better that it should not go on to the work unnecessarily. In re-preparing a fine grained plate the time of application of this solution should be about three minutes, and for the coarse grain about five minutes. Having re-prepared the plate, wash well with water and dry quickly with blotting paper or tissue

paper, not with a cloth. The drying must be done by direct dabbing down upon the moisture. The final drying is done with a fan. The metal is then clean enough to draw or transfer upon. Another method, which is so effective upon stone, is to roll up well as already described, treat with the 5 per cent. solution of nitric acid, wash off quickly. Then scrape whiting upon the surface, sprinkle with water and rub the surface of the plate with a felt stump for about two or three minutes. This generally proves sufficient; but to be quite sure, treat the surface carefully with the alkaline solution—3 per cent. bi-carbonate of soda in water. Then wash off, dry quickly, and execute the drawing in ink or crayon, or put down the transfer.

When the additional work consists in a complete alteration, then methods similar to cleaning an old plate, as already described in Chapter V, under aluminium, may be employed. The method is, briefly, to remove work with turpentine or petroleum and a little pumice powder, followed by benzine, and finished with the nitric and hydrofluosilicic acids and water, the greatest care being taken not to scratch the plate. This method, however, is cumbersome and not expedient in most cases. A more simple method is to roll up well as already described, clear off the gum, and proceed to apply concentrated sulphuric acid, with the glass brush, to those parts to be removed. When the work has been eradicated, wash well with water, dab off the surplus moisture with blotting or tissue paper, and prepare the surface for the new work with weak oxalic acid, or with the oxalic and nitric acids and water mixture, diluted with more water. Dab the plate and fan dry quickly, when the new work may be added.

This method may be carried out with another variation. Instead of rolling up well and dusting with talc, the plate may be gummed thinly and the work washed out with "doctor." When that has evaporated the gum must be all washed off, and the parts of the plate where new work has to be drawn are cleared of old work with concentrated sulphuric acid. Or the mixture of Terra di Siena and oxalic acid well diluted may be rubbed over with a felt stump, instead of sulphuric acid. After about three minutes' application in either case the plate is well washed and the solution of oxalic and nitric acids and water allowed to remain on the plate for about five minutes; the plate is then well rinsed and dried quickly.

New work can then be drawn in ink or crayon, or transfers put down.

After any of the above methods have been completed and the new work added, the plate must be treated as for new original work. The work must be dusted with talc, etched with either gum solution 12, 20 per cent. phos. acid 1, or gum water 70, syrupy phos. acid 1, the etch remaining on the plate half a minute, and the following procedure as already described in Chapter IX.

It may be added, the etch known as L-AN-B No. 3, consisting of a powder of which 5 ozs. should be stirred into one gallon of cold water for two or three minutes, has proved very effective when used as the second etch for originals, and the etch for transfers on aluminium. The Zetch second etch is equally useful.

SET-OFFS.

Set-offs upon aluminium must be treated with more care than for stone or zinc. The ink used for pulling the impression must be as free from surplus grease as possible, as the slightest trace will ultimately come up on the plate. The set-off impression should be pulled on a smooth, well-calendered paper—not necessarily hard sized or non-absorbent. If the paper be slightly absorbent there will be less opportunity of the grease of the ink going down to the stone. The set-off powder should be made of :—

Terra di Siena	...	...	... 2 parts
Frankfort black	...	...	... 1 part

Bronze blue may be added in small quantity or even substituted for the Frankfort black.

The set-off may be made more permanent by using a mixture of :—

Aniline mauve	...	...	... 5
Magnesia ...	...	...	... 5

They can be run down on a slightly damp plate, or, if care be taken, the plate may be moistened with turpentine and a few drops of carbolic acid or Izal oil or Cresylic acid. This will give a permanent set-off.

PRESERVATION AND STORAGE.

Before putting away aluminium plates, roll up quite firmly, fan quite dry, dust with talc, and gum evenly and thinly.

On top of the gum wash out with a "doctor." Wash the gum off and re-gum the plate. Each plate should be wrapped up in paper, and stored separately in a dry rack in a cupboard. No injury will result from packing up all plates of one design separately in paper, and tying them all up together.

When these plates are again required, they should be gently warmed, then washed out with "doctor," before damping off the gum and rolling up. A good rinse of water with a spray after removing the gum is also beneficial.

To all gum used for putting plates away, whether for a day or two or for months, always add a few drops of Calvert's Carbolic Acid, No. 2, to prevent the growth of fungus.

It is recommended that the work should be rolled up in a special preservation ink, consisting of:—

Spermaceti	4 ozs.
Beeswax	6 ,,
Good litho. ink	4 ,,
Olive oil	1 ,,
Glycerine	½ ,,

TRANSPOSING.

Transposing upon aluminium is perhaps one of the easiest and most curious manipulations in the whole treatment of this metal. Use a fine-grained plate, and roll it up solid with transfer ink, or draughtsman's ink reduced in turpentine. Pull a good impression from the subject to be transposed in good printing ink on smooth transfer paper and dust with finely powdered oxalic acid, as though it were a set-off. Lay this transfer set-off face up on the damp book for a few minutes and then lay it on the inked face of the aluminium. Pull it through to make it adhere; remove the transfer paper; then pull through with a slightly damp backing to pick up the excess of oxalic acid. Rinse well with water under the tap, when it will be found that the oxalic acid has killed the transfer ink on the plate and has produced an almost perfect transposition. The plate is dried quickly; it may be damped and rolled up and etched with the weak etch slightly, then rolled up again, etched and gummed ready for proving.

The action of the oxalic acid is so drastic as to draw a clean line of demarcation between its use upon stone and zinc, as against its use on aluminium. The action which takes place may lead many printers to use oxalic acid in varying strengths in other useful directions.

CHAPTER XII.

PRINTING FROM ZINC AND ALUMINIUM.

In addition to the numerous references to printing from zinc and aluminium which have been made in the preceding chapters, there are some items which are more or less confined to machine work. It is frequently desirable to etch work into relief when a long run of fine work is required.

The method of etching for zinc is practically the same as for stone. The work is rolled up ready for printing, it is then dusted with a resist such as talc. The plate may be etched into relief with nitric acid and water. The acid should be very weak at first, so as to remove the surface of the zinc and form the first step of the pyramid, the apex of which bears the actual work. It is well to wash off and examine the plate after three or four minutes to see that no undercutting is taking place. The etching may be continued until sufficient relief is obtained. After the completion of the etch, treat with the ammonio-fluorosilicate, or L-AN-B No. 1 solution or Zetch first etch, to give a water-absorbent surface.

For aluminium the initial stages of getting the work on the plate are as already described. For etching into slight relief the work is rolled up and dusted with a resist such as rosin and talc, or asphaltum, and the etching carried out with a saturated solution of hemi-chloride of copper, to which is added a solution of acetic acid 6 and water 10, until it turns the deep green copper solution to a light blue tint. Before etching damp the plate all over the front. The action which takes place is deposition of copper and liberation of hydrochloric acid ; the latter attacks the plate. The action must be watched and rinsed off well with water after a few moments. If the etching is to be repeated brush off the copper and apply the solution again. Whenever this etch is used it should be brushed over the surface whilst on, to ensure regular action. When the etching is completed rinse well with jet or

spray ; brush off the copper and treat the plate with concentrated nitric acid to remove all copper, following quickly with plenty of water. The plate must be dried quickly and treated with the gum 8, 20 per cent. phosphoric acid 1, or L-AN-B No. 3, or Zetch. After which it must be washed, dried and rolled up for the machine.

In the cases of zinc and aluminium, this etching virtually destroys the plate for further use, more so with aluminium than zinc, as the latter is thicker and may be polished down again.

DAMPERS AND DAMPING.

In printing from plates the dampers and damping board must be re-covered with a new clean material, as there must not be any trace of the solutions used for stone work left in them. The brass or zinc rider, recommended many years ago, should always be used on the dampers, as it collects any stray dirt from them.

The damping apparatus of the rotary must be kept scrupulously clean. An occasional wash up of the metal rollers with flannel soaked with dilute phosphoric acid and a little pumice powder is effective. The dampers themselves must be occasionally picked over to clear them of loose and dirty fibres.

The care required in printing from aluminium, so far as the dampers are concerned, is to see that when the plate is left on any occasion, however short may be the time, that no water can possibly dry slowly on the plate ; and more especially, always remove the dampers far away from the plate whenever printing is stopped and there is likely to be either a short or long stoppage.

In printing from zinc or aluminium always commence with a surplus of water, and gradually reduce the quantity whilst the ink is being fed up to the proper quantity. On no account use sour gum on the plates.

Damping on rotary machines is generally excessive because the dampers lose their shape by constant pressure unless the more modern damper with a thick rubber core be used.

INKING AND ROLLERS.

The inking rollers for plates should be of fine nap, and for aluminium or zinc india-rubber-covered rollers possess few if any advantages. The adjustments of the machine should

be such that the rollers, on commencing the inking, should already be revolving at a proper speed to prevent skidding on to the plate, and forcing the plate to initiate their rotation. This is so well provided for in rotary machines that they are the best form of machine for plate printing. They, too, have the damping rollers so worked as to prevent any undue pressure or friction upon the plate.

Treatment with the ammonio-silico-fluoride mixture, or L-AN-B, or Zetch, apparently makes it easier to print some metallic inks, such as vermilion, which are said to give trouble. But it is well known that since the use of phosphoric acid became general for zinc, there has been little or no trouble with such inks, providing they are well ground. In preparing an ink, the varnish should be so well ground into the pigment that each particle of pigment is encased within a film of varnish, and is effectually prevented from acting on the plate. There are, in fact, extremely few instances where any difficulty has arisen, and there is little doubt these were due to badly ground inks.

For aluminium the inks must be exceedingly well ground, and should not be used unless fulfilling this condition. In printing tints the ink should be worked as stiff as possible. Before printing from aluminium, run a sheet through, with inkers and dampers raised from the plate. If the work appears faint on the plate, add a little fatty matter to the ink and it will strengthen it. Warm water should be used in winter for damping ; in summer it must be kept cold.

In printing from metal plates in rotary machines the inkers must be carefully adjusted so as to just bear on the plate to ink the work, but no more. The use of the "Ideal" rollers has been considerably adopted with satisfactory results.

The pressure on rotaries should be adjusted to a fine nip, by springs if possible.

For printing bronze blue from plates, soften the ink with a little Venice turpentine, or balsam of Tolu, or syrup of diachylon with varnish. The ink must not be mixed with too much strong varnish.

When bronze has been printed first it has an effect on the plates printed from afterwards. This must be carefully watched, and whenever possible a tint varnish should be run over it before proceeding.

Always keep the temperature of the printing room up to 70 degrees F. in winter, especially for aluminium.

The use of rubber rollers in printing from plates may be carried to excess. If too numerous it frequently follows that they squeeze too much moisture off the plate, and cause difficulties in the damping operation. A proper number of rubber and leather rollers should be used, and although it is usual that the two leading inkers may be rubber and the others leather, placing the rubber rollers as the second pair of inkers may prove effectual. Rubber rollers may be entirely dispensed with.

New leather roller skins, when used on rotaries, very soon become loose and must be tightened up.

The ink for rotaries should always be fairly stiff to start with, as the speed of the machine in all its parts creates heat by friction, which thins the ink to some extent.

The use of magnesia or starch in tint inks is frequently effective in keeping them firm and preventing scumming.

The "German Lithographer's Year Book," 1907-8, states that the following mixture may be used instead of pure varnish : —Thin varnish from which the superfluous fat has been extracted has some magnesia ground into it. Then add sal ammoniac until the mass is ductile, add an equal quantity of sulphuric ether and paraffin ether, the amount of the two together being about one-fifth of the whole of the previous mixture. This mixture must be well ground and kept well protected from evaporation ready for use.

DAMPING WATER AND SCUM.

For keeping the scum off zinc plates it is recommended that a strong solution of tea be used. A solution of golden syrup is also effective, and a very weak solution of bi-carbonate of soda may prove useful. If the plate has been treated with the L-AN-B No. 1 solution or Zetch as the final etch, it is stated that the L-AN-B No. 2 solution or Zetch will prevent any scum. In that case pure water alone should be used for all damping purposes. In the case of aluminium it is also stated that if the plate has been treated with L-AN-B No. 3 solution or Zetch for the final etch, then the L-AN-B No. 4 solution or Zetch will be effectual in removing and preventing scum. In any case the use of a wooden stump or felt pad with a little pumice powder and the L-AN-B or

Zetch will remove scum which will not yield to the solution alone. Of course great care must be exercised in using any abrading powder, as scratches are detrimental to good working. If scratches do occur, the plates should again be treated with L-AN-B No. 1 or 3 respectively or Zetch, or equivalent solutions as already described in previous chapters.

It is possible to minimize the trouble of scumming on plates by the addition of a little Canada Balsam to the printing ink. Other remedies for scumming are quoted in the details of recipes (69–76).

DRY LITHOGRAPHY.

For some years past—possibly twenty or more—there have been visions of, and not a few attempts to find some means of doing away with the necessity of damping the lithographic stone and the zinc or aluminium plates in process of printing from them. It has been a cardinal point to consider and accept the original principle that water must be used to keep the printing surface moist to prevent the printing ink catching on that surface, as well as upon the design. It has seldom been anticipated that a change in the nature of the printing ink, or a complete change in the material used as the printing surface would ultimately solve the question at issue. Yet, after the practice of lithography for 126 years, there appears to be a method, or methods, on the lines suggested above, whereby one of the supposed difficulties of planographic printing can be overcome. For convenience of popular recognition this may be termed dry lithography.

The method of dry lithography, which was brought to the notice of printers in the autumn of 1926 under the title of

PANTONE,

the joint invention of Mr. Ronald Trist and Mr. Guy Symmons, in connection with the Sun Engraving Co., London, did much to show that the metallic plate can be iron instead of zinc or aluminium.

In this invention the iron plate must be either alloyed with chromium or an actual compound of chromium and iron. Upon such a plate a sensitive photographic film may be spread (as in all other direct photo-lithographic methods), and exposed under a negative. It is subsequently rolled up

and developed, and the unexposed film cleared from the plate, by a weak solution of hydrochloric acid. When the plate is dry it receives a thin silver plating, after rubbing with mercury and chalk, and is then ready to print from, in any printing machine, by using the printing ink into which has been incorporated a compound of mercury.

The theory is that whilst the mercury does not prevent the ink adhering to the design on the plate, it reacts physically (and not necessarily chemically) on the silver and prevents the adhesion of the printing ink.

In the experiments it has been shown that a plate so produced may be mounted in the chase with ordinary type surrounding it, can be printed satisfactorily and with no perceptible injury to the type metal. This demonstration was a run of some 120 reams on a Miehle press, and the halftone illustrations had the more pleasant appearance of "gravures," rather than the "dot" of cross-line blocks.

The whole process is protected by patents.

It may be noted that in 1878 Julius Husnik published a book entitled "Die Heliographie" in which he describes his experiments with copper, mercury and chromium in producing printing plates. It will be remembered that the combination of Husnik & Hausler was credited with very early—if not quite the earliest—three-colour printing from blocks; and the book quoted above contains a chapter on photography in natural colours.

In the "Penrose's Annual," 1896, on pages 35–36, is the article "Mercurographie with Quicksilver," by Jos. Scholefield, who will be remembered as a lithographic artist in Bradford. According to his practice he used various salts of mercury, and incorporated such salts in drawing crayons and inks.

DAMPERLESS PRINTING.

This method of printing is concerned wholly with the printing ink itself, and its general composition as gathered from the patents is the introduction, amongst other things, of calcium chloride into the printing ink. By this addition it has been undeniably proved that any work in any colour, including fugitive inks (so composed) can be printed successfully on the ordinary lithographic flat-bed machine from stone or metal plate, and for months (in 1926) it has been run on a

Waite & Saville offset rotary machine. The mode of running and the attention required are the same as for offset or flat-bed machines, except that owing to the absence of dampers the attention necessary is reduced to at least one-half.

In this patented method there are no extra costs for printing plates, and no time or materials used in the preparation of the plates. The ink should not cost any more. On the whole it is the nearest perfect approach to dry lithography that has ever been consummated. The inventor is Mr. W. P. Price.

The cylinder blanket should be as firm as is consistent with good work. If it be too elastic or soft, it may give smeared impressions.

Chromo papers, when used on rotaries, give off a little of the coating at each impression, and, in course of time, the action of the coating particles on the work may prevent solidity of work.

Throughout these chapters turpentine has been mentioned without any suggestion as to the use of substitutes, such as have been on the market under various names for some sixteen years. Each one has its own characteristics, and has been more or less successful in doing work previously done by turpentine only. The improvements in these substitutes have been considerable, and the turpentine substitutes, Nos. 1 and 2, made by Messrs. Hughes & Treleaven, of Liverpool, specially for use upon zinc and aluminium, fulfil satisfactorily all the general requirements of turpentine. The "Decco" turpentine has been well tried and found satisfactory. For photo. processes use pure turpentine.

CHAPTER XIII.

SPECIAL PLATES AND SOLUTIONS.

MÖLLER'S PATENT PLATES.

1883. *Patent No.* 2836.

As so much of the present day treatment of zinc is so similar to the method of using the "Litho-Plate," introduced by Messrs. C. & E. Layton (or "The Litho-Plate Co.") 56 Farringdon Street, London, it is interesting to quote extracts from the foolscap circular of January, 1887, as follows :—

Bed plates were made from demy to quad crown at £6 to £10 10s. each. (Patent 710. 1885).

"Etch" or treatment of new work on plates:—

20% sol. of potassium bichromate in water	½ pint
Weak gum solution	½ „

To be kept in a dark bottle (wine or stone), and only make sufficient for a fortnight, as it deteriorates.

The "etch" used as weak nitric acid is used on stone:—

Phosphoric acid (Sp. Gr. 1.5) ...	1
Water	1
Strong gum solution	30

Strengthened for use after scraping a plate by more phosphoric acid.

The cleaning solution to remove the work:—

Stick or strongest caustic soda ...	2½ ozs.
Clean (distilled) water	1 pint.

Original work on plates by crayon or ink. Use fresh ink rather stiffer than for stone. Work can be taken out with turps. or benzine. After rolling up scraping may be performed to lighten tints, or take out spots in stippling, so as to expose the zinc only, and following with the stronger phosphoric etch. Originals were treated ("etched") with the potassium bichromate mixture, sponged on thinly; allow to

dry; wash out with turpentine only on the dry "gum"; roll up until solid, then sprinkle with water and roll till sharp and clear; soak off any adherent "gum"; finally etch with phosphoric acid. Clean up with wooden (acid) stump, using the caustic soda solution mixed with turps. Rinse off quickly with clean water or gum sponge. Any scraping for reducing tints, or removing defects may be done at this stage, but only baring the zinc, and immediately apply the stronger phosphoric etch. Gum up, wash out and proceed to prove.

Finger marks on the plate should be removed with benzine before any other treatment.

Transferring may be done on dry or wet plate. Hot water must not be used on these plates.

The transfer paper is damped off, and the work treated exactly as for originals above.

Additions may be made by clearing the gum off, and cleaning the plate with citric acid, then washing with clean water. When dry make the addition.

Alterations are made by carefully clearing off the work with turps. and water and a flannel. Follow with careful treatment with the caustic soda solution, and wash quickly with water. Dry; apply some etching; wash; apply weak citric acid; wash well; dry, and make alteration. After either addition or alteration, treat with the potassium bichromate and gum, and following treatment as for originals and transfers.

Storing the plates was done by gumming up thinly, drying, and wrapping in paper—not gumming the paper on. When required wash off the gum with water and a thin film of the potassium bichromate and gum. When dry, wash out with turps. only and proceed as for originals and transfers.

In the machine all the usual safeguards were recommended. For long runs an occasional treatment with potassium bichromate and gum, allowing it to dry, proved effective. At the end of the day, the plate was rosined, etched and dried, then washed off and left under gum.

Engraving could be executed similarly to stone. Cover the plate with etching, dry and wash off with water. Lay a ground of red or black with gum. Engrave or sketch the design or drawing so as to bare the zinc and just cut the surface. Broad and fine lines to be engraved the same depth.

Faults to be covered with "etch" coloured with red or black. When complete, fill in with linseed oil; remove surplus oil with dry cloth (not a water damp cloth); roll up solid black; dab ink on any part appearing bare; finally, soak off the grounding and surplus ink and prove. Such plates could be printed in the machine or treated as copperplates.

Plates could be entirely re-cleaned by the same treatment as for preparation for alterations, provided the work had not been on a long time.

PENROSE'S "LITHO-ZINC" PLATES.

Specially contributed by Messrs. Penrose & Co.

The Penrose Litho-Zinc Plates are manufactured under the patents of G. H. Block, who since 1887 or before then had been engaged in developing metal plate lithography. As special or prepared zinc plates there is little doubt that these are practically amongst the best, even if they are not actually the best.

These plates are not simply sand-ground, but undergo a course of chemical treatment which imparts to them an eminently suitable surface for either direct drawing or transfer work. The grain can be either extremely fine for direct photo-printing, or in any degree of coarseness down to that required for bold chalk drawing for poster work. Their light tint makes them more acceptable to lithographic artists for direct drawing than plain zinc, and they are particularly advantageous for colour work. Transfers are made upon these plates in the same manner as on a litho stone (wet or dry). Mr. Block's method of treatment with potassium bichromate and gum is the substitute for the first etch, and after the solution has been spread evenly over the plate, leaving only a slight film, it is allowed to dry thoroughly. The work can then be washed out with turps. or with a special washing-out fluid. The plate is next sponged over with water, damped with a cloth and rolled up, when the work will appear clean, sharp and strong. This method can be equally applied to transfers or originals. An important advantage is that alterations and additions of new work can be made on these plates by means of a special re-preparing solution. The part which requires altering is removed with a mixture of equal parts of Erasol solution and turpentine

applied with a small piece of felt or flannel, and then rinsed well with water. A special Prepasol solution for restoring the sensitiveness of the plate is applied with a camel hair brush to the parts where the work has been removed, and after the solution has remained for a few seconds it is rinsed off with water. This operation is repeated several times till the surface looks clean. There is little possibility of the old work coming up when the plate is re-prepared by this method. When old plates have to be re-prepared, it is recommended that they should be sent back to the makers, if users are within easy reach, but arrangements can be made to enable lithographers to re-prepare the plates themselves. Mr. Block applied his methods with equal success to aluminium.

The special solutions to be used with these plates are:—

No. 1. Prepasol solution, or re-sensitizing fluid, used as acetic and citric acids are in lithography.

No. 2. Erasol solution for erasing work, to take dirt or greasy spots out of the plate, much in the same way as caustic soda or potash is used on plain zinc.

No. 3. Chromosol solution, to be poured on the plate with the moist gum and mixed together. It acts as the first etch for new work.

No. 4. Atzol solution : used as all second or final etches are on zinc.

No. 5. Firmasol or "doctor."

For clamping zinc or aluminium plates effectively on the usual style of iron bedplate, Messrs. Penrose & Co. supply a very simple and effective bending machine for turning over the edge, so that it can be clamped. They have, however, recently introduced a new form of bedplate, which does not necessitate the plate being bent over. This is particularly suitable for plates which have to be put into photographic printing frames, as it is difficult to flatten out the plates again, if they have to be re-prepared for further use.

LITHO-ZINC PLATE TREATMENT.

For originals and transfers gum up with fresh, strong, clean gum, and sprinkle solution of potassium bichromate on the plate, distributing and mixing them with a clean rag. Gradually remove the surplus of this mixture with the rag, until only a thin film remains to dry on the plate. After,

say, five to ten minutes—not longer—wash out the work on the dry gum with turpentine, and apply the washing-out fluid (No. 5) with a clean soft rag. No water must be used in this operation. Having allowed the "doctor" to dry, sprinkle with water, and with a slightly-charged black ink rag go over the work, clearing off the gum and surplus grease. Roll up well, fan dry, dust with talc, and apply the etching solution (No. 4). Using a sponge for this etching it may be applied to the plate several times, and by squeezing the sponge out the etch may be reduced to a mere film; fan dry quickly. The plate is ready then for proving.

For proving in colour gum up afresh with bichromate solution, dry, and wash out with turpentine and clean rag only. Then with turps and colour rub up with a rag.

Whenever a plate is taken up for working—especially old plates—gum up with bichromate solution, dry and wash out as for originals. The bichromate treatment prevents scum on the plates. The plate may be kept clean in printing by occasionally using a few drops of tartaric acid ½ oz. and water 1 pint. Scum can generally be removed and prevented by good rubbing over with gum.

If desired, transfers may be treated as for stone, omitting the bichromate treatment. The etching is applied after rolling or rubbing up and dusting with talc. The etch is washed off and the plate gummed up. The gum must be left to dry, and the work washed out on the dry gum with clean flannel and turps.

In treating crayon drawings, commence with etching solution and gum solution in equal quantities and apply it with a fine camel hair brush. Remove the etch with clean water, gum up thinly and dry; proceed to wash out on the dry gum, roll up solid black; sprinkle with water and wipe off surplus gum and ink; roll up, dust and etch as before. Whenever a plate is to be washed out always gum thinly, dry, and wash out on the dry gum.

Set-offs may be put down on dry plates. If the special set-off powders containing aniline dye are used, the plate may be damped with either pure clean turpentine or benzine.

Alterations and additions may be made by rolling up well in black and dusting with talc. The work is removed by rubbing with felt stump or rag and solution of half turpentine and half etching. Rinse well with water and apply the

re-preparing solution several times until the plate looks thoroughly clean. Dry off with white blotting paper and make the necessary alteration or addition. Then treat with the bichromate solution as for originals.

Additions only may be made by rolling up well and dusting with talc. Prepare the plate with the re-preparing solution reduced to half strength with water. The solution should be rinsed off after a few seconds and applied two or three times similarly. Dry off with clean white blotting paper. Make the addition and proceed as for originals, with bichromate solution, etc.

Printing in the machine should be preceded by rolling up, dusting with talc and etching. The etch should be reduced to a thin film and dried. Wash off with water, gum up thinly and dry. If colour is to be printed wash out with turps on the dry gum. Allow it to evaporate, then sprinkle with water and remove all the gum and black ink with a soft clean rag. Roll up in the required colour in the machine.

At night the plate should be rolled up in black and etched and gummed up with half gum and half bichromate solution, a piece of brown paper being placed all over the plate to prevent the action of light. In the morning re-start the plate as already described above for commencing printing.

Spots of dirt may be removed with a wooden stump and half etch and half turpentine. If this be not strong enough use some of solution No. 2 with a little gum, and follow with the etch.

In printing, the damping water may be half cold tea, or a few drops of the etch may be added to the pailful of water. A little vinegar and a little gum may be added for the same purpose.

In printing use approximately half thin and half middle varnish for the inks. Avoid grease in every way, and an occasional treatment with bichromate solution is very beneficial.

Scumming frequently arises from using the ink too thin. Gently rubbing with strong gum and soft felt should remove it; rolling up and etching occasionally is of advantage. If charcoal or polishing stone be used, or if scraping be resorted to, the place should be treated with re-preparing solution and finally etched.

The ink for drawing on these plates should be half Lemercier and half Vanhymbeeck's inks. It should be freshly made and not too thin.

"Litho-zinc" plates are sold by Messrs. Penrose & Co., 109 Farringdon Road, London, E.C.

PARKER PRINTING PLATES

are prepared by Frank Horsell & Co., Ltd., by a secret process and made from the finest grade of zinc obtainable, and are proved by a recent analysis to maintain a standard of purity of 99.700. The metal is specially prepared and rolled and every plate undergoes a most searching test and selection, so as to eliminate all faults and flaws. The ordinary commercial qualities of zinc are not sufficiently pure to be suitable and invariably contain flaws and defects which are altogether detrimental to fine work such as offset and photo-litho, etc. Every plate is manufactured under the supervision of an expert and sold with the makers' guarantee of replacement should the plate prove faulty. These plates were first introduced in 1906, and are largely used.

The Parker Printing Plates are chemically treated to prevent oxidation, if reasonable care be taken to keep the plate free from damp when not in use. Also the plates should not be subjected to extreme heat, or moisture allowed to condense on the plate. They are made in varying sizes and gauges as required for different makes of machines.

The Parker Printing Plates are grained by a combined mechanical and chemical process in a variety of grains to suit different requirements, and each plate is carefully examined before being sent out.

The descriptions of the various grains supplied are as follows:—

No. 1. Grain for photography or fine line work.
No. 2. Grain for originals or fine flat-bed work.
No. 2x. Grain for offset machines.
No. 3. Grain for labels and light chromo work.
No. 4. Grain for heavier chromo work.
No. 5 and No. 5x. Grain for poster work.

Parker Printing Plate Metal has greater ductility than ordinary or commercial zinc and aluminium, and the plates are less liable to have the edges broken.

Frank Horsell & Co., Ltd., are the sole European manufacturers of the Parker Plate, and also issue for use on these plates (or any zinc plates) a set of solutions, numbered 1 to 7, and these being standardized will be found to be an advantage over the more or less haphazard method of mixing chemicals in the litho shop.

The solutions are sent out each with a distinct colour, so the lithographer can see at a glance which solutions he is using.

Nos. 1 and 2 combined make the etch solution, 1 oz. each of Nos. 1 and 2 mixed with 16 ozs. of thin gum arabic solution is the correct strength for average work.

No. 3 is a washout solution, for use on any form of plate or stone; it possesses strong greasy and penetrative properties, and is a preservative of designs when stored away for any length of time.

No. 4. A solution for adding to the damping water to keep down any scum that may arise; add about half a cupful of No. 4 to a pail of water, more or less according to requirements.

No. 5. An erasing solution for the removal of old work. Clean the parts to be removed with turps. or benzine, taking care that the other work on the plate is rolled up well and protected with rosin or talc, then dry the plate and apply No. 5 solution with a brush (keep it off the hands), add a little powdered pumice and rub in a circular motion until all grease is removed.

No. 6, Re-sensitizing Solution. For use add one part No. 6 to 15 parts of water, more or less according to the work in hand. This solution removes the gum and etch compositions from the plate, leaving it clean to receive new work.

No. 7, Re-graining Solution. For use in the graining machine use 1 part No. 7 to 20 parts of water.

Messrs. Horsell's Silicacine Graining Grit can be obtained in the following grades:—

B. Grit for fine matt machine work.
F. Grit for all offset machine work.
H. Grit for labels and light chromos.
K. Grit for heavier chromo work.
L. Grit for open chalk drawings.
S. Grit for heavier poster work.

This is a satisfactory graining medium of even texture and may be used without hesitation.

Original work in ink or crayon is etched with etching solution, reduced to half strength (No. 1, 1 oz.; No. 2, 1 oz.; gum arabic solution, 32 ozs.), applied with a soft brush and washed off immediately with gum solution. Then go over the plate with a damp soft cloth to smooth the gum; fan dry; wash out on the dry gum with the "doctor," No. 3 solution thinned with turpentine; again smooth the surface and fan dry. The work is then ready for rubbing, or rolling up and proving. If some of the work requires strengthening, or new work is to be added, roll up well in good stiff ink, thoroughly clean the plate with water, dust the work well with talc (French chalk), and proceed to sensitize or clean the parts where work has to be added with No. 6 solution 1 to water 15. Allow this to remain on the plate five minutes; wash well with clean water, fan dry, and add the work with ink or crayon. Treat the new work the same as an original, i.e., with etch and "doctor," before rolling up. If the work has already been etched and rolled up, and alterations are to be made, proceed to wash the gum off well, after rolling up, and dust with talc. Treat the parts to be altered with benzine to remove the ink and varnish. Apply solution No. 5 to eradicate the grease, using a piece of felt and a little sand. No. 5 solution is strong and should not touch the hands. After this treatment a little stain may remain, which is of no consequence. Wash well with water, fan dry, and rub lightly with fine sand; brush off the dust; make the alterations and treat with etch and "doctor" as for originals before rolling up.

Transfers should be pulled fuller than those for use on stone, to allow for the grain upon the plate. They can be run down either upon a dry or damp plate.

Use as heavy a pressure as possible, damping the transfers occasionally, and run through the press until the moisture has completely penetrated the paper. Wash off with clean water, remove any register lines or other matter not wanted with fine pumice stick and gum up with an even coating of gum arabic.

When the gum is dry, wash work out with No. 3 solution on top of the gum and allow this to dry. Then remove the washout with water and roll up the work. When fully charged

with ink, dry the plate and dust with a resist, either French chalk or rosin, and etch the plate with Parker Plate Etch, Nos. 1 and 2. This is best applied with a soft camel-hair brush. Allow the etch to remain on the plate for about two minutes, then wash off with water, removing all trace of the etch, and gum up and dry.

The plate should be again washed out with No. 3 solution on top of the gum and it is now ready for printing.

PRESERVING PLATES.

When it is required to store plates for any length of time, the best method of treatment is as follows :—

See that the plate is in good order, then roll up with black ink, coat evenly with gum arabic and dry, wash out the work with No. 3 solution on top of the gum, leaving a slight film of the solution upon the plate. Store in a dry place and it will keep in this condition indefinitely. When required for use simply wash off with water and roll up.

In machine work use short (buttery) inks. Use as little water as possible, and if using thin greasy inks, use No. 4 solution to avoid scumming.

In using these plates avoid sponges which have any trace of nitric acid in them. Never use sour gum, and keep the plates in a dry place.

The Parker Plates are sold by Messrs. F. Horsell & Co., Ltd., Victoria Road, Leeds.

ALGRAPHY PLATES.

The plates of aluminium supplied by Algraphy, Ltd., Philip Road, Peckham, London, S.E., for aluminography are grained in three grades—matt, medium and coarse—and these seem to meet all the requirements of the trade.

The procedure with these plates is generally as already described in the previous chapters. New plates after lying in stock should always be freshened by treating with sulphuric acid 1 part, and water 10 parts.

A plate to be re-prepared has the work removed, either by turpentine, benzine, carbolic acid, or a suitable combination of these. The plate should then be washed and immersed in the nitric acid bath (nitric acid 1, water 3). The nitric acid must be free from hydrochloric acid. Leave the plate in the

bath ten to twelve hours; remove and rinse it; then grain by hand or machine.

For rapid re-preparation, remove work with turpentine and pour on some of the plate-cleaning fluid "D," assisting its action by rubbing with a piece of felt, until the work has quite disappeared and the plate assumes a bright colour. Wash well and re-grain.

The treatment for originals is to dust well with talc, and sponge over quickly both ways of the plate, with the etching solution or Zetch. Squeeze the sponge as dry as possible and again go over the plate to remove the surplus etch; finally, gum up and fan dry. Wash out on the dry gum with the washing-out fluid or "doctor" "B." Allow it to evaporate, then wash off the gum and roll up, using a fine soft rag for damping.

Rubber or Ideal rollers are recommended instead of leather. After rolling up well dust with talc and give the plate a good etch or Zetch solution. Wash off, gum up, fan dry and proceed to prove.

For alterations, roll up well and dust with talc; remove the work with sulphuric acid containing a little gum; after three or four minutes' action wash off quickly with water; dry the plate and apply the re-sensitizing solution "C1," allowing it to act for five minutes, then wash off with clean water; dry the plate, make the necessary new drawing or transferring, dust with talc, etch, etc., as described, and proceed to prove.

For set-offs a powder may be used consisting of 1 lb. red raddle (raddle is a red earth coloured by sesquioxide of iron) and 1 oz. violet aniline powder in equal quantities, mixed in water; dry by heat and pulverize to powder in a mortar. The plate may be damped slightly and the set-off run down.

For transferring use Berlin or French transfer papers. When using French paper damp the plate slightly with alum water (alum 1 tablespoonful, water 1 pint). Always clean the plate on front and back. Use about eight sheets of soft pliable backing; run through a large number of times (15 to 20); remove the paper with warm water, leaving the composition. At this stage work may be added to or removed from the plate; gum up, fan dry, and wash out with the "doctor" fluid "B"; fan dry; wash off with tepid water and roll up; dust with talc and etch with the transfer etch; gum

up; fan dry, and proceed to prove or print. It is advisable to allow plates to stand an hour or two before printing.

The dirt or spots on the plate may be removed with a stick of charcoal, or soft india-rubber. A wooden stump with the etch may also be used.

The machine rollers may be nap leather, Ideal or rubber, but not glazed. Solid rubber on the stock is preferable to rubber tube drawn over packing. But if the packing is quite even, as when Horsell's Seamless Packing is used, rubber rollers made upon packing are quite satisfactory. Rubber rollers must be washed with petroleum, wiped and dusted with talc or magnesia.

The graining of aluminium plates, when produced in the machine, should be regulated to obtain the grain desired by the length of time occupied, size of balls, and size and nature of "sand," as follows:—

Matt surface for transfers and drawing on: 50 minutes graining with balls of maple or lignum vitæ, about $\frac{7}{8}$ in. diameter, and pumice powder through an 80 sieve.

Grain for copperplate transfers: 30 minutes with glass balls about $\frac{5}{8}$ in. diameter, and flint emery through 120 sieve.

Grain for machine plates for commercial work and solid colours: 30 minutes with glass balls about $\frac{5}{8}$ in. diameter, and flint emery through 100 sieve.

Grain for fine chalk work and long runs of commercial work: 30 minutes with glass balls of 1 in. diameter and 100 sieve sand.

Grain for medium chalk work: the same, but use 80 sieve sand.

Grain for poster work: 25 minutes with glass or porcelain balls of $1\frac{1}{8}$ in. diameter, with granite sand, crushed shingle or crushed flint through 60 sieve.

Grain for photographic work should be done by hand with a felt pad and pumice powder through 160 sieve.

From time to time the balls should be thoroughly examined, all those with flaws or flattened surfaces being removed.

The process was introduced by the Algraphy Syndicate in 1897, and was taken over by Algraphy, Ltd., in October, 1898, the capital of the Company being raised by public allotment for the purpose of acquiring the patent rights for the United

Kingdom and Colonies. The process met with an immediate success, the largest printers installing the plates for flat-bed printing. Its general adoption was, however, greatly hindered by the high price of the metal, aluminium at that time standing as one of the most expensive metals; further, the Company insisted upon a royalty being charged and agreement signed before the process was installed in any printing works. Despite these restrictions a ready sale for the plates was found, and when the graining machine and the rotary were introduced by the Aluminium Plate and Press Company of New Jersey, U.S.A., the demand for the plates was such that the metal could not be produced in sufficiently large quantities to fill the orders, and supplies had to be obtained from Germany and America.

The patent rights of the Company having now expired, printers are at liberty to use all the formulæ previously belonging to the Company. The method of treating aluminium as advised by "Algraphy" has been very largely adopted. The price of the plates, their durability and other features, have ensured their extensive adoption for rotary machines.

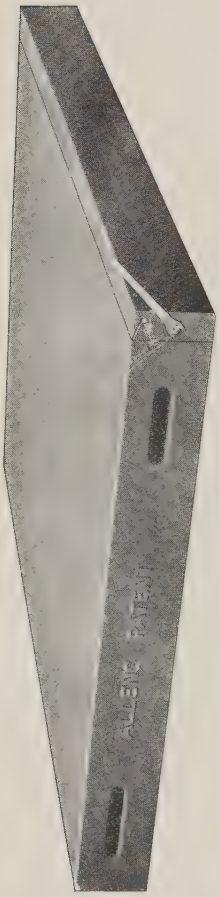
The Company also makes the "Alco" zinc plates. The metal used is commercially pure, and the fine mechanical grain serves as a good water-retaining surface. The treatment of these plates is the same as for plain zinc.

The method of fixing the plate on the bedplate is as follows:—Screw the extension bar close to the bed; place the edge of the plate, with its doubled edge outwards, in the grippers at the opposite side to the extension bar, fasten up the grippers and proceed to bend the plate down on the flat bed. Place a sheet of clean paper on the face of the plate, then a flat piece of wood near the gripped edge, and with a mallet gently and evenly hammer the plate down to the proper bend. Release the grippers and insert the other edge to be bent similarly. Then the plate can be placed in both sets of grippers and expanded over the bed.

BEDPLATES.

Of the many bedplates constructed to meet all the variations of the plate edges, which in most cases require doubling over to give a firm, even gripping edge, there are some which do

not require the doubling over of the plate edge. Most bedplates are constructed with the disadvantage that the plate becomes bent all along the gripped edges. Further, practically all bedplates, with a single or one-piece gripper, as well as those with several separate grippers, have to be tightened up at several places, to grip the plate. To a very considerable extent these drawbacks have been overcome by the bedplate patented in 1918 (No. 118,545) by C. J. E. Allen, of Southampton. The principle utilized in this invention is similar to the two inclined planes (wedges) which raise the bed of the carriage in many flat-bed lithographic printing machines. Such wedges are drawn up one over the other by a screw, so set that it pulls the lower inclined plane in one direction and the upper inclined plane must rise over it. Whereas in the machine carriage such planes are large and admit of considerable rise to suit different thicknesses of stones, in this bedplate the rise is very small, because the thickness of printing plates used shows but a small variation. From this brief explanation it will be seen that when such inclined planes are put to the front and back of a bedplate, supported in a framework which has an overlapping tongue extending the whole length of the bedplate, over the two inclined plane bars, that it requires a very small turn of the screw to bring the upper plate into gripping contact with the tongue of the framework. The grip obtained is so forcible and even, that irregular plate edges are of little consequence. In actual use a flat printing plate is inserted at its edge under the tongue of the frame, and usually a quarter turn of the screw brings the gripping block into firm contact and secures the plate. The very slight incline of the gripping tongue and block does not make more than a mere bend in the plate, which when removed afterwards is readily straightened out again. At the back of the bedplate is a similar gripping frame, which can be "screwed" away from the bedplate to give the necessary flatness of the plate on the bed. There are many instances in which the back gripping appliance is not used, as the plate will lie flat by its own weight. As the grip can be obtained by a quarter turn of a screw, it will be seen that a plate can be removed and another put into position in possibly two minutes. The whole operation of clamping is effected by the turning of a screw at the edge of the bedplate and is readily accessible.



Allen's Patent Bedplate. George Mann & Co., Ltd.

Bedplate. A. W. Penrose & Co., Ltd.

"ZETCH"

FOR ETCHING LITHO-ZINC AND ALUMINIUM PLATES.

This recent concentrated form of etch was actually used by the maker in 1914, and after years of experience under all conditions was brought into public notice by Algraphy, Ltd., in 1922. The inventor of this etch is well known amongst his many colleagues as one of the most enthusiastic and philosophical exponents of the use of zinc and aluminium, and the discovery of the etch was made as a result of his continuous experiments to simplify the treatment of printing plates.

The etch is made up as a powder of which 4 ozs. are mixed with 1 gall. of warm or cold water, well stirred, and is then ready for use.

The standard solution—made up of 4 ozs. of Zetch powder and 1 gall. of water—is the normal etch as used for originals or transfers. It can be varied in strength by adding a little more water for a weaker etch, or by adding very little more Zetch powder to increase its strength. Alternately, the standard solution will effect the same purpose as a stronger solution, by allowing it to act on a plate for a slightly longer time.

METHODS OF USE.

By referring to Chapters VI, VII, IX, X, and the tables of treatment in Chapter XVI, it will be easily seen in what ways this etch simplifies the usual operations.

1. When the original drawings are in thick lines, and masses, heavy stippling, Day's medium, or when copperplate transfers have been put down to plate, the usual first etch is omitted and the procedure is:—Gum the whole evenly and thinly and dry it. On the top of the dry gum wash out the original or transfer with turpentine and wipe it dry. Then with a special clean rag apply a strong washing-out fluid or "doctor," made with the sensitive bitumen, as already described in Chapter VI. When this has evaporated to dryness, wash off the gum, and incidentally the "doctor" that was on the gum; the work can be rolled up. Use a good black ink, roll the work up until it is quite sharp and is quite solid. Dry the plate and dust the work with talc, then clean off all "dirt" with a quill or

wooden stump dipped into a solution of caustic potash. Wash the plate well with water and apply the Zetch standard solution with a sponge or soft pad of flannel; continue to wipe it over the plate for about two minutes, then wash the plate well with water, let it drain off, and gum up evenly and thinly. The plate is then ready to print.

2. When the original is fine line work or stipple, or fine crayon drawing, or re-transfers, proceed as before to gum up and dry. Then wash the gum off, damp the plate and roll up with good black ink to obtain sharpness and solidity. Follow with dusting talc all over, and apply the Zetch solution as described above.
3. Machine plates should be rolled up well, dusted with talc and the Zetch solution applied for one minute. This will ensure a long run and clean printing.
4. Before printing, wash out with turpentine over the dry gum, wipe over after evaporation, and apply the "doctor" fluid. Fan the plate dry, wash off the gum with clean water and sponge; wipe off excess of water and commence rolling up in the machine for printing.
5. Re-preparing zinc plates. The method here suggested has, from experience in using Zetch, been found effective:—

   Remove the old work with a solution of caustic potash, 1 lb. in water 1 gallon, and clean it all over, back and front. Any unevenness of the plate should be hammered flat, or polished down. Then flood the plate with a solution of sulphuric acid 1 oz. to water 1 gallon. This neutralizes the alkaline potash and gives the plate a "whiter" surface. After a thorough wash, back and front, the plate has to be re-grained in the usual way. After graining wash well, and immerse for two or three minutes in the solution of ground alum 1 lb., nitric acid 3 ozs., and water 2 gallons. Finally, wash well with water and dry quickly, when it is ready for new original work or transfers.

THE STRECKER PROCESS.

The Strecker Process consists essentially of treating the plate with a solution after it has been rolled up and etched,

which forms upon the plate a glaze or coating having the power to hold moisture and repel ink. In the Patent Specifications, especially No. 2234 (1902), some weight is put upon the possible electrolysis which occurs when certain chemicals are brought in contact with zinc (and aluminium). Concerning that, however, it is not necessary to enter into any discussion, but the solutions used call for some reference. In describing the effect of certain re-agents, it is stated that some of them may only result in a decomposition of the salt used, or the deposition of a caustic layer unfit for printing surfaces. It is stated that using silico-fluoride of ammonia results in a decomposition into hydrofluoric acid, silicic acid and ammonia. In a small treatise by Blecher (*see next page*), Dr. Otto C. Strecker recommended the use of equal parts of ammonium silico-fluoride and ammonium nitrate with water and gum, which upon experiment on zinc, using little or no gum, gives a satisfactory result, and in the Specification (1902) is shown how this combination results in the formation of zinc fluoride, ammonium silicate, ammonium nitrate and water. The treatment described, proceeds:—

In preparing the plate it is treated with:—

Acid fluoride of ammonia	5 ozs.
Ammonia	3 ,,
Water	1 gal.

This removes grease and impurities. The plate is well washed, dried and grained, and finally washed with nitric acid—50 drops in 1 pint of water. When washed and dried the drawing or transfer is put on; followed by gumming up, drying, washing out with a "doctor." Then wash off and roll up the work; dust with rosin, finishing with soft pad and talc. Then treat with:—

Ammonium acid phosphate ...	22
Ammonium nitrate	20
Gum solution	200
Water	1000

The solution is applied with a brush and allowed to act for two or three minutes, thus producing the required layer on the zinc or other metal, which will retain moisture and repel ink. The plate is then ready for rolling up and printing. This constitutes the Strecker Process.

The solutions are now made up under the name of "L-AN-B." They are variously prepared to suit the first and second etching and use in the machine, for both zinc and aluminium.

The small treatise by Blecher, entitled "The Treatment of Zinc for Lithographic Printing, by the Special Process of Dr. Strecker" ("Die Verwendung des Zinks für den Lithographischen Druck, nach dem Verfahren von Dr. Strecker"), published by W. Knapp, Halle, was reviewed in *The Process Engravers' Monthly*, January, 1907. In the brief translation given, the most important part is the recommendation of Dr. Strecker to use either of the following mixtures for the final etch:—

1. Ammonium silico-fluoride 1
   Ammonium nitrate 1
   Gum water, sufficient to dissolve.

(This may be allowed to act for about two minutes)

or

2. Ammonium bi-phosphate 1
   Ammonium nitrate 1
   With sufficient gum water.

In actual experiment, however, less gum and more water prove more effective.

In the same treatise the graining agents recommended are:—Emery 000 to 0, finest pumice, yellow sand, flint sand and grit, which will sift through 120, 70 and 50 sieves for the various grains. The graining balls should be 20 mm. ($\frac{7}{10}$ in.) diameter, 25 mm. ($\frac{1}{5}$ in.) and 30 mm. (1 in.) for fine, medium and coarse grains. The graining balls may be ordinary flint pebbles, spheres of glass, porcelain or wood, or potato-shaped porcelain pebbles. The graining with finest pumice and emery 000 should occupy 40 minutes and all others 20 minutes. It may be added that the use of emery at all is very doubtful; it has a strong tendency to scratch.

The Strecker Process has been fully dealt with in all its bearings in the treatise by E. Eberle and J. Goodman, entitled "Metalithography." This work, however, includes some of the details already quoted in the previous chapters of this treatise; whilst the actual use of the "L-AN-B" fluids may be summed up as above, with the supplementary matter culled from the Specifications of Patents, numbers 6701 (1900), and 2234 (1902).

In dealing with the uses of "L-AN-B," the above authority states that it may be used with a wooden stump, as acid is used, but with the addition of some rouge or pumice powder, for cleaning off spots of grease.

In treating a zinc plate for the production of transpositions, it is recommended to cover the plate with a film of "L-AN-B."

For the process of etching half-tone or line blocks the "L-AN-B" solution is recommended for the first treatment after the work has been inked up.

It might be here added that W. Dickes in his patent, 16884 (1884), claimed the use of solution of "silicate or other substance" which would give to the plate a kindred property to litho stone to absorb water, and in principle forestalled the Strecker Process by some eighteen years.

Again, in 1892, H. Bittner, in his patent 12688, carried out apparently the methods of Dr. Strecker as indicated in his 1900 patent by electrical deposition, and in his patent of 1902 by mere chemical change during contact with the zinc. Bittner preferred an alloy of $\frac{2}{3}$ tin with $\frac{1}{3}$ zinc, although he claimed that it would affect any metal. He prepared the plate by immersing it in a bath of silicate suspended in an emulsion of gum arabic and water. From this bath it was taken and immersed in another bath of nitrate of lime and water. In treating the metal by this process an insoluble compound of the zinc was formed by the silicate bath, and followed immediately by the nitrate bath which oxidized the hydrogen evolved in the silicate application, thus producing a salt on the zinc of a hygroscopic character, like lithographic stone, and consequently repellent of grease when damp. The plate was afterwards treated with lime water containing a little sulphuric and hydrochloric acids. This latter application could have done little, for the slaked lime would be converted into chloride of calcium and sulphate of calcium, both of which would have little or no effect upon the salts already deposited, more especially as after the final treatment the plate was well washed and dried.

DR. STRECKER'S METAL PRINTING PROCESS.

Specially contributed by Lowe & Brydone Printers, Ltd.

Dr. Strecker, who is one of the authorities on chemistry as applied to printing, was amongst those who early advocated

the use of zinc instead of aluminium, and he perfected a method the success of which seems to justify the claim that zinc is a better medium for printing purposes than aluminium. The process has for many years been popular on the Continent, in America and in this country, where it has made great progress.

The great principle involved in the application of this method is to produce and maintain a perfect water-retaining layer on the uninked parts of the plate surrounding the design to be printed. Senefelder himself is known to have made experiments with metal plates, zinc especially; he was perfectly aware that metals have an affinity for fat, but he evidently did not succeed in producing a satisfactory water-retaining surface. Many attempts to utilize metal plates have since been made, but it is safe to say that the invention of Dr. Strecker is the first real solution of a difficult problem. By this method an insoluble layer is produced on the portion of the plate not covered by the design, which is strongly water-attracting and so completely ink-repelling that runs of 100,000 and more can be worked off the transfer with ease, the last print being as sharp, clear and clean as the first. This layer is produced as the result of an electrochemical process, by means of which "L-AN-B" (Roderzone) this being the name under which the etching preparation is now sold, forms with the metal of the plate fresh substances which are part soluble and part insoluble. The soluble substances are washed off and the insoluble form the hygroscopic layer. The latter is perfectly insoluble in water and weak gum compound acids, but it can be easily removed by treatment with nitric acid which restores the surface to its former condition, and renders it highly sensitive to fat. An important feature of "L-AN-B" (Roderzone) is that it never corrodes the plate even if frequently used on the same part. Some of the other methods require the use of acids which corrode the plate, and if used repeatedly to overcome scum, tinting, etc., undercut the fine lines and make the work "rotten," or cause it to disappear altogether. "L-AN-B" (Roderzone) produces a definite oxide compound with the metal, and therefore further oxidation is impossible. This is another important advantage of the process, as the subsequent oxidation in other processes is often the cause of trouble, especially in connection with aluminium.

In spite of the many advantages which zinc offers in comparison with aluminium, the price of the plates is a little cheaper, the cost of zinc being rather less than the cost of the best aluminium plates. Zinc plates are, of course, sold in the market at prices which vary considerably, and it is well to remember that for this process no expensive "prepared" plates need be purchased, as ordinary good unprepared zinc can be used. It is not necessary to return the plates to the makers for re-preparation, as they can be quickly and cheaply re-prepared by any stone preparer, providing that he understands graining plates. In addition to the advantages enumerated above, and which apply more or less exclusively to this method, there are, of course, others which are the common feature of all metal printing methods in comparison with stone. There is no risk of breakage which, especially in the case of the big stones, is a serious item in many shops. No trouble from veins, chalk patches and silica spots can occur when metal plates are used. A considerable saving is effected by reason of the easy handling of the plates, since even a 60 × 40 in. plate can be handled by a boy, whereas it requires several men to lift a stone of the same size. Firms who print from stone in their machines employ metal plates for storing originals, on account of the great saving in space effected thereby. Transferring and making ready on the machine can be accomplished in less time and with greater ease; the pressure once obtained and set with the machine carriage, remains virtually constant when metal plates are used. The life of the zinc plate is fully equal to that of the lithographic stone, notwithstanding the infinitely smaller cost of the metal, and it is not surprising to learn that plates treated by this method last much longer than those etched with acids, as they are not continually exposed to the corrosive action of the acids.

The methods of working the process are, briefly, as follows:—When the plates have been bought in their natural state they are first treated with nitric acid to remove the hard, scaly skin, which appears on such plates. Then the plate is put into the graining machine or is grained by hand, the graining material being chosen according to the grain required, fine or coarse pumice powder, sand, etc. After graining, the plate is treated with a weak solution of nitric acid and alum, and it is then ready to receive either

the original drawing or the transfer. The method of drawing upon zinc is practically the same as upon stone. Transfers are also fixed on the plate in the usual manner, the plate being afterwards gummed, dried and the transfer washed out, for which operation the special washing out solution "Phir-mold" is recommended. The plate is then inked with a strong black ink until the negative is well covered and clearly defined; the "L-AN-B" (Roderzone) solution is then applied and allowed to act upon the plate for from two to four minutes according to the character of the work; when its action is complete, a hygroscopic layer will be adhering firmly to the plate. The plate, having been well washed, is gummed and dried, and is ready for printing from. Plates upon which the work has been printed down by a photographic process should be treated with "L-AN-B" (Roderzone) in order to ensure freedom from scum, tinting and oxidation whilst printing, and to lengthen the runs. Plates prepared by this process may be printed by flat-bed or rotary machines, direct or offset, with the same inks as when printing from stone. The rollers may be either "nap" or "Ideal." It is well to use a sufficiently large quantity of water, but not too much, at the start, but the water should be gradually lessened and the ink increased. To use plates again for transferring after they have been printed from in the machine, wash the plate with turpentine, turps. substitute or paraffin to remove the ink; then treat the plate with a strong solution of caustic soda, this will remove the grease from the plate, and after having thoroughly washed the plate in clean, cold water, it is then put into the grainer and treated like new plates as previously described. Plates treated in this way show little wear after being used hundreds of times.

Zinc plates are recommended on account of their cheapness and their general suitability, but as the principles of this process also apply to other metals, especially to aluminium, and as many printers hold a large stock of aluminium plates, and have long been accustomed to this metal, the etching preparation is made as suitable for aluminium as for zinc. The usefulness of aluminium is greatly increased when used in connection with this process. The great drawback of aluminium plates, viz., their liability of oxidation, is completely overcome by the use of this method, for, as before explained in connection with zinc, the "L-AN-B"

(Roderzone) produces an oxide compound with the metal and, therefore, further oxidation is impossible.

Lithographic printers are always safe when using 'L-AN-B' (Roderzone) as it contains No Chromic Acid.

Lowe & Brydone Printers Ltd. announce that no licence whatever is necessary to work this process, and they will be glad to give full information regarding it to anyone upon application.

WINSTONE'S "VICTORY" ETCH.

Winstone's "Victory" Etch, one of their leading lines of the "Victory" series of lithographic specialities, has been on the market for several years, and has been used as the standard zinc and aluminium plate etch in many of the leading houses in London and the provinces. The method of application is as follows :—

TRANSFERRING.

When the work has been transferred to the plate, gum it with a thin layer of gum, smooth over with damping cloth, fan dry, wash out with Winstone's "Permaneo" or wash-out solution. Again fan dry, roll up solid, damp over and roll away all superfluous ink, leaving the work clean, sharp and solid. Gently dust with asphaltum powder, finishing with French chalk (talc) all over plate, cleaning away any spots or dirt with a pointed stick, picker, snakestone or rubber; apply the etch evenly over the plate, allowing it to remain three minutes. Wash off with water sponge, gum in. When dry, wash out with "Permaneo" solution, and the plate is ready for the machine.

MACHINING.

Clean the back of the plate before fixing. The plate has to be treated as a stone during the make-ready, gumming in when the machine is not in motion. No fanning dry is required. A little gum added to the damping water during running will be found beneficial. Any spots or dirt left on the plate can be removed by using snakestone or pointed wood with a little etch, being careful to gum over afterwards.

OTHER PLATES.

Although only the "Litho-Zinc," "Algraphy Plates" and "Parker's Plates" have been dealt with fully, it may be

added that most lithographic supply houses deal in plates. Zinc is so largely used that it probably takes the premier position in printing from metals. The simplicity of its treatment, as described in previous chapters, is so evident that it is unnecessary for any printer to use anything else. In using plain zinc the printer is not confused by having to use a number of "mysterious" solutions with index numbers, and providing the general chemical principles are understood, a printer can vary the recipes given in this treatise as occasion requires. It may be further stated, without fear of contradiction, that when the use of zinc is thoroughly mastered there are few printers who would use aluminium. Aluminium is certainly a fine metal, but its manipulation is more complicated, and it may be said more difficult than zinc, whilst the prints produced are only equal to those produced from zinc when properly handled. Aluminium plates of first-class quality are now very little more expensive than zinc. They can be obtained from almost any supply house. The best plates, however, are prepared by the firms making a speciality of them.

The same firms, seeing the great demand for zinc, have added facilities for zinc plate preparation to their equipment, and can be relied upon to supply plates of a high quality.

One, at least, of these houses guarantees to supply plates without pinholes, buckles or other blemishes. The plates are submitted to very hard rolling, which no doubt lengthens the life of a plate for any class of work. The same firm claims that the grain produced all over the plate is even. A reference to the microscopic productions from grained plates in a previous chapter will show that as a rule the grain is anything but even, and may account for much of the broken work with which the printer has to contend.

CHAPTER XIV.

NOTES ON CHEMICALS.

ACETIC ACID.

Acetic acid ($C_2H_4O_2$) the acid of sour beer produced by second fermentation: the acid of vinegar. Vinegar contains 5 to 15 per cent. acetic acid. The strongest or glacial acetic acid, obtained from the products of the destructive distillation of wood, contains on an average 95 to 97 per cent. acetic acid and it solidifies or becomes glacial at 62°F or 16.7°C. At this strength it blisters the skin.

The commercial acid is much weaker than nitric acid in actions upon metals. It forms aluminium acetate, known as red liquor, and used as a mordant by dyers and calico printers. Lead acetate, or sugar of lead, is another compound, well known as an eye lotion: it is poisonous. Copper forms an acetate known as verdigris, which is also poisonous.

The action of acetic acid on aluminium and zinc is so small that it may be disregarded. On lithographic stone, which is mainly calcium carbonate (chalk) acetic acid acts moderately well and forms long crystals of acetate of calcium. It is this re-action which militates against its use.

The crystals formed have a tendency to adhere to the stone and produce a false face on it. This false face may be drawn or transferred upon; but subsequently it rolls away as the crystals are dissolved or removed. Although this disadvantage has been known for forty years, yet acetic acid has been used instead of citric acid, or weak nitric acid. However, within the past five or six years it has been found that the addition of a little alcohol will prevent the adherence of the crystals. Acetic acid is not used for any special effect it may have, but it is on the basis that it is advisable to use an organic solvent to dissolve organic matter. Whatever truth there may be in this, it is well known that nitric acid breaks up gum-arabic into three acids, which are readily washed off the stone. Experience has shown that nitric acid, very

dilute, does the work of acetic acid in a much cleaner way, and it is apparent that acetic acid should be eliminated from use on stone.

CHROMIC ACID.

Chromic acid (H_2CrO_4) is a watery solution of chromium trioxide CrO_3 (possibly the strongest oxidizing agent known). The acid is obtained by treating a strong solution of potassium bichromate with sulphuric acid. The main feature of this acid is its powerful oxidizing effect. It is seldom used in the form of acid, as experience has shown that it is too violent in its action. It is usually used in its modified forms of bichromates.

Chromic acid is a dangerous acid to use, as it is injurious to the user. It has been suggested that factory regulations should exist to place it under dangerous chemicals restrictions.

CITRIC ACID.

Citric acid ($C_6H_8O_7$) is largely made from lemon juice. It is stronger than acetic acid, and in its action on stone, gives a "clean" bite, forming insoluble citrate of calcium, which can be readily washed off. For this reason it is preferable to acetic acid.

When applied to zinc or aluminium its action is imperceptible in the time usually given for etching, and, therefore, is not used.

CRESYLIC ACID (CARBOLIC ACID, IZAL).

Cresylic acid is the uncrystallizable liquid obtained in the manufacture of phenol, from coal tar. It is chiefly a mixture of cresols, of which there are three, viz., Orthocresol (C_7H_8O), Metacresol (C_7H_8O), Paracresol (C_7H_8O)—the molecules of which are grouped differently in each case. These cresols are obtained from wood tar and coal tar toluidines. They have an unpleasant smell, are antiseptics, and less poisonous than phenol (carbolic acid C_7H_6O). They are not oxidized by chromic acid.

Cresylic acid is cheap, and is soluble in turpentine and other essential oils, so that it can be used instead of Izal or carbolic acid. It has been tested in printing operations and found efficient.

Creosote is obtained by distillation of wood tar or coal tar, and may contain phenol, cresol, and methyl ethers (from wood); phenol, cresol, naphthalene and anthracene (from

coal). It is soluble in essential oil, but not in water. To make it soluble in water, as for Jeyes' disinfectant, resin and caustic soda are added to it.

Carbolic acid—phenol—as prepared by Calvert in two states is soluble in turpentine (No. 5 carbolic acid), or in water (No. 2 carbolic acid).

Izal, prepared by Newton Chambers, is soluble in water. They also make Izal oil which is soluble in turpentine. Jeyes' disinfectant is soluble in water. Creosote is soluble in turpentine.

Of these bodies Izal is not poisonous to human beings, and carbolic acid is most poisonous. They are all antiseptics and can be used in gum arabic solution or paste to prevent mildew and souring. In turpentine these bodies increase its solvent power remarkably, and no old ink in engraved plates, on blocks, stones, or plates, or on inking rollers can withstand its effect.

The amount used must always be very small, and all safeguards must be taken against poisoning. None of them are "acid" to litmus paper, and quite unlike nitric acid, etc.

GALLIC ACID.

Gallic acid, 3 : 4 : 5, Trihydroxybenzoic acid $C_6H_2(OH)_3COOH$, occurs in sumach, divi-divi, Chinese tea, valona, algarobilla. Formed from tannin by dilute solution of sulphuric acid ; and when tannin becomes mouldy. Is prepared from gall-nuts by maceration in cold water, decanting the liquid and allowing it to go mouldy, exposed to air. It is soluble in 130 parts cold, or three parts boiling water. Is readily soluble in acetone, and when that solution is heated above 240°C. it decomposes into CO_2 and pyrogallol. It gives a precipitate with albumen or gelatine.

TANNIC ACID.

Tannic acid ($C_{27}H_{22}O_{17}$), Tannin, Gallotannic acid, Gallotannin. Most abundant in gall-nuts on oak, and on sumach. Chinese and Japanese galls are very largely used. In commerce it is a faintly yellowish powder. Readily soluble in water or alcohol ; sparingly soluble in ethyl acetate; insoluble in benzine, ether or chloroform.

It gives a precipitate with albumen or gelatine.

It precipitates most alkaloids.

It forms insoluble calcium compounds.

HYDROCHLORIC ACID.

Hydrochloric acid, muriatic acid, spirits of salts, hydrogen chloride (HCl), is the acid constituent of common salt (NaCl), from which it is largely produced by the action of sulphuric acid.

It is a very powerful acid of about the same "acid activity" as nitric acid. It dissolves most metals and forms soluble chlorides of all except lead, mercury, and silver, which remain insoluble chlorides. It is used for cleaning metals before galvanizing, soldering and filling.

When mixed with an equal quantity of nitric acid it forms nitrosyl chloride, or aqua regia, which dissolves all metals and forms metallic chlorides.

It destroys or dissolves most animal and vegetable matter, including gelatine and fish glue, and can be used effectively in dissolving the calcium phosphate, etc., of bones, leaving the connective tissue from which gelatine can be prepared.

It dissolves stone, zinc, aluminium, copper, chromium, silver, mercury, nickel, lead.

HYDROFLUORIC ACID.

Hydrofluoric acid (HF), prepared by heating acid potassium fluoride in a platinum retort. Its fumes are dangerous if inhaled, and drops of the acid cause sores on the skin. The strongest acid is kept in platinum bottles, and weaker acid in guttapercha bottles.

It dissolves glass, and for that reason is used in cleaning collotype glass plates. It converts sand (silica) into silicon fluoride. It attacks most metals and non-metals, most of the salts formed are soluble. Calcium, iodine and bromine fluorides are insoluble.

It is used for etching on glass, in which the acid fumes produce a frosted appearance, and the liquid makes clear lines. Calcium fluoride is used as a flux in "Metallurgy."

HYDROFLUOSILICIC ACID.

Hydrofluosilicic acid (H_2SiF_6), obtained by dissolving silica (silicon oxide) in hydrofluoric acid. The strong acid fumes should be avoided. It forms salts of potassium and barium, insoluble in water or alcohol. The sodium salt is partially soluble: at 15 C. it is soluble to the extent of 0.6 per cent., and at 100° C. 2.6 per cent. Most other salts are insoluble, except copper.

NITRIC ACID.

Nitric acid or aqua fortis (HNO_3) is the acid constituent of nitre, saltpetre, or potassium nitrate (KNO_3), and cubic nitre, chili saltpetre or sodium nitrate ($NaNO_3$). The acid is extracted from either of these nitrates by double decomposition with sulphuric acid.

It is one of the most powerful acids, and attacks most of the known metals: those which it does not attack are, gold, aluminium, platinum, osmium, iridium, rhodium, tungsten, and other very rare metals which are not used in industrial arts. But when nitric acid and hydrochloric acid are mixed in equal quantities all these metals are dissolved and usually form chlorides.

Nitric acid does not attack non-metallic bodies, such as silica, quartz, mica, felspar, china clay, soapstone, talc (French chalk), glass, porcelain, pipe clay. Nor does it attack the lacs, resins and bitumens, which are of vegetable origin. On the other hand it attacks, destroys or decomposes animal and vegetable matter including fats, soap, glycerine, gelatine, glue, bristles, leather, gum arabic, paste.

In general use it frequently forms nitrous and nitric oxides, as brown fumes which are more or less poisonous. The strong acid usually fumes when the bottle is opened. These fumes should be avoided. Should a Winchester quart or carboy be smashed, it is advisable to go away from it and leave it for some time. If possible throw caustic soda, caustic potash or lye on the spilt liquid and vessel and leave it to neutralize.

It should seldom be used in printing processes of greater strength than 1 of acid to 10 of water. For special purposes it may be 4 of acid to 16 of water. And for the lightest forms of etching a solution of 1 or 2 of acid in 100 of water is ample. Thus, instead of using acetic acid, the weak solution of nitric acid is more effective.

As the general cleaning up solution the weakest nitric acid solution is preferable. As nitric acid is capable of attacking almost every material in use in printing—except aluminium, non-metals and resins—it is the best for all purposes.

In many cases nitric acid starts its action by forming oxides, which it ultimately converts into nitrates. Most of these oxides and nitrates are soluble in water, and all of them are readily washed away with a good flow of water. In printing

operations the cloths and sponges should be washed out thoroughly in plenty of clean water, and the clean water should be frequently removed.

One of the most useful cleaning solutions is a mixture of alum water, and nitric acid.

It is generally advisable after cleaning stone, zinc or aluminium with an acid solution, such as the alum-water-acid above, to scrape whiting on the surface, sprinkle with water, and rub it carefully on the bare plate, then wash it off with water. The whiting neutralizes the acidity on the plate and abraids the plate, whilst the small amount of free sulphuric acid in the alum just bites or freshens the surface.

OXALIC ACID.

Oxalic acid ($C_2H_2O_4$). It occurs as a compound of calcium or potassium in many plants, more especially in sorrel and rhubarb. The acid is extracted from sodium oxalate ($C_2Na_2O_4$). It is a white crystalline solid which is soluble in water. It is poisonous. When heated it decomposes into carbon dioxide and formic acid (both poisonous), and ultimately evolves carbon monoxide (poisonous). When used on stone it forms calcium oxalate as a glaze, insoluble in water, or acetic acid, but soluble in both hydrochloric and nitric acid. In photography the double salt of potassium and iron oxalate [$K_2Fe(C_2O_4)_2H_2O$] is used as a reducing agent and generally extracts oxygen.

Oxalic acid destroys printing ink, and frequently destroys the actual work immediately at the surface.

PHOSPHORIC ACID.

The main source of phosphorus compounds is the hard part of bones which is mainly calcium phosphate [$Ca_3(PO_4)_2$].

Phosphoric acid, orthophosphoric acid, or trihydrogen phosphate [H_3PO_4] is a peculiar acid and must be handled carefully. It attacks and decomposes organic matter, and burns on the flesh are difficult to deal with. The oxides and acids of phosphorus usually combine with water with a hissing sound.

It is a white crystalline solid, but is usually sold as a thick syrupy liquid. It is very soluble in water, and can be made of any desired specific gravity.

It readily attacks stone, forming the calcium phosphate; zinc is feebly attacked; aluminium shows no effect.

Copper, iron, lead, manganese, sodium, silver, and other metallic and non-metallic bodies form phosphates.

The etching action of phosphoric acid is due to its oxidation of the organic matter in the transfer and printing inks.

SULPHURIC ACID.

Sulphuric acid—oil of vitriol (H_2SO_4)—is produced commercially from iron pyrites (FeS_2), and other re-agents. Although it is not used largely in printing operations, yet it is by far the most important and most extensively used acid in commercial and chemical industries.

It is a thick "oily" liquid having a specific gravity of 1.854, compared with water at sp. gr. 1.000. Being heavier than water it sinks when poured in: in this operation great heat is evolved, and if the quantity of acid poured in is considerable the vessel, bottle or bowl, is liable to break.

It has a strong affinity for water, and is often used to absorb water, either in liquids or in the air.

It attacks most metals, and in conjunction with other acids (usually non-metallic) it assists in the extraction of non-metallic elements, and acids.

Dilute sulphuric acid attacks stone, zinc, aluminium, copper, mercury, silver.

In full strength it does not attack aluminium and several other bodies, largely due to its own density not allowing the gaseous products of decomposition to escape. It breaks up alcohol, oxalic and formic acids, into other compounds.

Practically all the commoner metals can be converted into sulphates, of which barium, calcium and lead sulphates are insoluble in water.

It is the ideal acid for use on zinc plates, as it can be diluted to the lowest point of activity, or used at almost full strength. It destroys animal and vegetable matter—such as gums, varnish, etc., but it has little effect on non-metallic bodies.

ACID AND ALKALI TESTS.

Litmus is the colouring matter extracted from special lichens which grow in Norway, Sweden, Canary Islands, and on the shores of the Mediterranean Sea. The colouring matter is stained into chalk and gypsum. This dye is termed Azolithmin. The solution is made blue by adding a little alkaline solution, or made red by adding acid. The

paper—unsized, unglazed—is dipped in the blue solution for use as an acid test: another batch of paper is dipped in the red solution for use as an alkali test. The solutions themselves may be used for colouring liquids, for tests.

Blue litmus paper dipped in acid solution, turns red.

Red litmus paper dipped in an alkaline solution, turns blue. Litmus paper or solution is a very certain test in all cases, even when the acid or alkali is in very small quantity. As carbon dioxide affects litmus, any solution containing a carbonate must be boiled first, to expel carbon dioxide.

Turmeric is obtained largely from the roots of an E. Indian plant belonging to the ginger family; and from a W. African shrub. A powder is prepared from the roots. By further treatment the orange colouring matter—curcumine—is obtained. Unsized paper is soaked in the solution and dried.

Turmeric paper is not affected by acids, but it turns chocolate brown in alkalis. There is an exception in boric acid solution, which turns turmeric brown. Therefore, if a solution turns litmus red and the same solution turns turmeric brown, it is a certain test of the presence of boric acid.

1. Iodœosin (Erythrosin), used in presence of ether in titrating *dilute* solutions of acids or alkalis. Acids turn it orange; alkalis turn it cherry red.

2. Methyl Orange, with acid becomes pink and with alkalis yellow.

3. Congo Red, with acids, blue: with alkalis, red.

4. Lacmoid, with acids, red: with alkalis, blue.

5. Litmus, with acids, red: with alkalis, blue.

When testing a carbonate the liquid must be boiled to expel carbon dioxide.

6. Turmeric, with acids, yellow: with alkalis, brown.

7. Phenolphthalein, with acids, colourless: with alkalis, purple. Cannot be used for ammonia.

The first four are more sensitive to alkalis; the last three are more sensitive to acids.

ALCOHOL.

Alcohol—ethyl alcohol (C_2H_6O)—is produced when yeast grows in a sugary solution. The growth of yeast requires oxygen, which it takes from the sugar and water, and alters

the chemical composition until alcohol is formed. Absolute alcohol is the purest spirit obtained by distilling it with potassium carbonate or quicklime to withdraw all the water.

Alcohol evaporates in air, and boils at 173 F. or 78.4 C. It does not solidify in any ordinary temperature in any part of the world. It is very inflammable: it absorbs moisture to a large extent, and is consequently used to assist drying.

Many salts and gases dissolve in alcohol. It is used as a solvent for resins to make spirit varnishes, etc.; also for organic bases and essential oils (scents and turpentines), which do not dissolve in water. Some coal tar dyes are soluble in alcohol.

Alcohol mixed with 10 per cent. of wood spirit (a mixture of methyl alcohol, acetone, allyl alcohol, etc.), or 10 per cent. of a mixture of wood spirit and paraffin, is known as "methylated spirit."

By oxidising alcohol it is converted into aldehyde (Acetaldehyde C_2H_4O) and then into acetic acid ($C_2H_4O_2$). The alkali metals, potassium, sodium, etc., attack alcohol and form ethylates. It may be possible that the calcium in calcium acetate acts in a similar way. Hydrochloric acid attacks alcohol very slowly and forms ethyl chloride. Hydrobromic and hydriodic acids act similarly, and form ethyl bromide and ethyl iodide. Strong sulphuric acid and alcohol form hydrogen ethyl sulphate.

DRIERS.

In ordinary language driers are substances added to oil paints and printing inks to increase their drying and hardening qualities.

More specifically, driers are chemical substances which apparently supply oxygen which oxidizes the paint or ink mixture and thereby causes hardening. There are other substances which readily evaporate and by their evaporation assist in drying. Those bodies which supply oxygen may do so at their own expense, or may serve as carriers of oxygen from the air. A few oils are in themselves drying oils, such as linseed, hempseed, nut, poppy, candle nut, madia, German sesame, etc. On the other hand there are many oils which have little or no drying quality, such as colza, cotton-seed, croton, castor, olive, rape, ground-nut, etc. But as drying oils are too slow in drying for commercial purposes, especially printing, it is necessary to add

some chemical substances to hasten the drying or hardening. In some cases the pigments added are of such character that they act as driers. This is the case with the chromates of lead used to make chrome yellows, orange and red ; the hydrated carbonate of lead used for flake white ; similarly when lead oxides are used as litharge ; iron and manganese silicates used for umber. In this line of chemical science it may be added that the following pigments exert a strong drying tendency when made from mineral sources, viz., raw and burnt sienna, raw and burnt umber, cyanide blue (the prussian or bronze blue series), mixtures with flake white, mineral green, ultramarine, cobalt, ochres, Chinese or permanent zinc white and zinc chrome yellow.

It is, however, necessary to meet the cases of non-drying pigments by adding drying chemicals to the printing inks. Such bodies exist as manufactured articles in considerable numbers and the following list may be quoted.

Litharge, scaly yellow monoxide of lead, ground to a paste in a drying oil, which is usually linseed oil.

Boiled oil is linseed oil heated to 210° up to 260°C. (410° to 500°F.) with a small quantity of litharge added. If manganese dioxide be added instead, the colour is slightly deeper.

Gold size is much the same as boiled oil, except that a yellow or other ochre is added. This composition has, however, been set aside, and the following are two of the manufactured articles:—

Linseed oil 10 gals., litharge 7 lbs., red lead 7 lbs., lead acetate 3 lbs.

Linseed oil 7 gals., litharge 7 lbs., zinc sulphate 2 lbs., gum animi 5 lbs., turps 12½ gals.

Copal varnish. Copal is a name given to a number of semi-fossil resins found in the soil near the roots of gum-resin trees. It is mostly from the tree Trachylobium verrucosum of Africa. Sierra Leone copal melts at 190°C. (400°F.). There are, at least, fifteen varieties of "copal," some of which are animi. It is both a drier and adhesive.

Terebene is made by treating terebenthene—the chief constituent of French turpentine—with concentrated sulphuric acid. It has the odour of thyme oil or pine

wood, and boils between 156°C. and 180°C. (313° and 354°F.). It is insoluble in water, and readily soluble in organic solvents. Terebene is imitated commercially by a mixture of gum copal 840 lbs., hot raw linseed oil 180 gals., and fine litharge 45 lbs. There are other imitations as follows:—

Linseed oil 40 gals., manganese borate 33 lbs., lead acetate 33 lbs., litharge 33 lbs., manganese sulphate 33 lbs., and turpentine as required.

A still more powerful "Terebene" is:—

Linseed oil 40 gals., litharge 100 lbs., manganese sulphate 66 lbs., calcium acetate 33 lbs., and turpentine as required.

Zinc sulphate may also be used in "Terebene."

Diachylum or Diachylon is made by boiling hydrated oxide of lead with olive oil. It has a similarity to boiled oil, but is made with a non-drying oil instead of the drying oil, linseed.

Manganese linolate; and oleate.

Cobalt linolate; and oleate.

Manganese, borate; resinate; and benzoate.

Cobalt, borate; resinate; and benzoate.

Lead acetate; hydrated-carbonate (flake white); chromate.

Zinc oxide (Chinese white); sulphate; chromate.

Manganese sulphate; and dioxide.

Cobalt acetate.

Most of the metallic driers are liable to affect or be affected by the metallic pigments used in making inks.

The metallic driers should not be mixed, as they are liable to interact and become non-drying compounds.

The organic compounds, e.g., manganese linolate, cobalt resinate, supply the stronger driers. Cobalt linolate is useful as a drier.

Balsams of Tolu, Peru, and Storax are resinous driers.

Canada Balsam is an oleo-resin which has useful binding properties and is a slow drier.

As there are many metallic compounds which are driers, it is advisable to give the list of metals in their order of merit (as driers), as follows:—Cobalt, manganese, chromium, nickel, iron, platinum, lead, calcium, barium, bismuth, mercury, uranium, copper and zinc.

ETHER.

Ether $(C_2H_5)_2O$ can be made by mixing potassium ethylate and ethyl iodide.

Ether is very light, and is partly soluble in water: water also being part soluble in ether. It boils at 94.1°F. or 34.5°C. The vapour burns with a luminous flame, and with air it forms an explosive mixture. Ether dissolves fats and oils, and is therefore used in the Soxhlet apparatus for dissolving the varnish and carrying it away from the pigment in printing inks: whilst alcohol is used to dissolve and carry away the coal tar dyes of printing inks.

ALUM $[Al_2(SO_4)_3 + K_2SO_4 + 24H_2O.]$

Alum is a term applied to a series of compounds containing double sulphates. The true alums always contain aluminium sulphate, together with an alkali sulphate. Thus common alum, the article always sold as alum when no specific alum is required, is the double sulphates of aluminium and potassium. In other alums the potassium is replaced by sodium, or ammonium. There are also some other (pseudo or false) alums in which either potassium sodium or ammonium is present, and the other metal may be chromium (in chrome alum), iron, or aluminium.

Alums are astringent, and are used as mordants in dyeing. They also supply the base (aluminium) for many lakes used in printing. Generally alums have an acid re-action, owing to a small amount of free sulphuric acid. Experience has shown that alum solution too freely used on printing surface has a tendency to thicken or broaden the lines of the work.

AMMONIA.

Ammonia—spirit of hartshorn (NH_3)—is mainly obtained from the ammoniacal liquor of gas works. It is a colourless gas, with a characteristic smell. It is very soluble in water—1148 volumes are soluble in 1 vol. of water at 0°C. This solution is the commercial "liquor ammonia" which may be obtained at a standard strength of 0.880 specific gravity.

It is strongly alkaline and neutralizes acids, with which it forms salts such as ammonium chloride $(NH_4Cl.)$, ammonium nitrate (NH_4NO_3), etc.

It appears to quicken some chemical actions, and by some operators is used in larger quantity than formerly in photo-

process films, with a view of making the subject firmer on the plate.

As it evaporates quickly it is sometimes used to assist drying, and at other times to cool the particular work in hand.

BICHROMATES.

Potassium bichromate ($K_2Cr_2O_7$), a red crystalline body, soluble in water at 68 F. or 20 C. in the proportion of 13.8 pts. of the salt to 100 water. It is somewhat poisonous; insoluble in alcohol; and on heating decomposes into the chromate, chromic oxide and gives off oxygen. The solution of potassium bichromate is slightly acid. The characteristic quality of this compound is that it will give up some of its oxygen under proper conditions. Combined with the fact that it is slightly acid and that it oxidizes, it would appear that it makes the action of fatty acid stronger, and may even produce a similar body to fatty acid. When incorporated in a solution of gelatine or fish glue, and exposed to light, as a dry film, the bichromate loses some oxygen, and is reduced to chromic oxide.

The quantity used in making the light sensitive film must never be excessive, as if so it will crystallize throughout the film and destroy it for photographic work.

BICHROMATE OF SODIUM.

Sodium bichromate ($Na_2Cr_2O_7$). This bichromate, although so rich in oxygen, is seldom used in photo-process films, because it readily absorbs moisture and causes the film to be unstable.

BICHROMATE OF AMMONIA.

Ammonium bichromate $(NH_4)_2Cr_2O_7$. This salt is frequently used alone in photo-process films. Generally it is used along with potassium bichromate, to shorten the exposure. It is more soluble in water than potassium bichromate. Used in excess it forms rings in the film.

It should be noted that the bichromates must be used carefully, as they are liable to cause sores on the hands.

CAUSTIC SODA, POTASH, LYE.

Caustic soda—sodium hydroxide, sodium hydrate (NaOH)—is formed when the alkaline metal sodium is immersed in water. Commercially it is prepared from carbonate of soda (washing soda, or soda ash) solution.

Caustic potash—potassium hydroxide, potassium hydrate (KOH)—is prepared in similar ways, by using potassium carbonate.

Lye is often a solution of caustic potash; but it is a general term for various solutions. It is not advisable to use it when it is chemically necessary to use a pure alkali.

All these bodies are alkaline, potash being much the strongest.

The caustic soda and caustic potash solutions dissolve fats and form soaps. They form salts with acids and neutralize them, as also does ammonia. For example, hydrochloric acid mixed separately with each produces sodium chloride (table "salt"), potassium chloride (strong table "salt"), and ammonium chloride. Caustic potash dissolves in alcohol, and this solution is largely used in organic analysis to remove the elements of acidity.

The main use of these bodies is to dissolve the greasy varnish of inks and leave the surface clean and free from grease. They are moderately cheap and very soluble in water. It is not advisable to use them on aluminium, as they dissolve it. On zinc there is also a slight action.

In the case of stone, by using nitric acid, the calcium is oxidized and forms quicklime, which with the water present forms caustic lime which destroys all grease and gum upon it.

CHROMIUM.

Chromium (Cr.) is a hard, white metal. It does not occur as a metal, but is found combined with other metals and silica. In the metallic state it oxidizes in moist air. With hot dilute hydrochloric acid, also with sulphuric acid, it is dissolved and forms chromous chloride and chromous sulphate. It is slowly attacked by nitric acid.

FORMALDEHYDE.

Formaldehyde (CH_2O) is a colourless gas and is formed when the vapour of methyl alcohol with air is passed over a red-hot spiral of platinum wire. When it is so formed and at once led into water it passes into solution and is known as formaline.

It is a strong disinfectant and preservative, as it kills bacteria.

It reduces several metallic oxides to the pure metals.

As it reduces and is a disinfectant, it may be taken that it

has a tendency to harden and destroy the organic character of gelatine, etc., and prevent their usual activity. Thus, any photographic film treated with formaline becomes non-absorbent of water to its usual extent. A photo-litho. transfer so treated cannot be rolled up a second time.

GELATINE.

Gelatine is an albuminoid of variable chemical quantities of carbon, hydrogen, oxygen, nitrogen, and traces of sulphur. It is obtained in varying hardness, from: (1) Ivory and other horns, bones of mammals; (2) parchment, fish bones; (3) soft skins and fishes' swimming bladders; not to mention the glues made from hoofs and rough skins.

It is a jelly formed from the connective tissue after extraction, cleaning and heating. It has very little affinity for anything, but is destroyed by most acids, and hardened by others, such as gallic and tannic acids. Formaldehyde hardens it; alcohol precipitates it from solution. It is not soluble in cold water, but will absorb six or seven times its weight of cold water, and is then readily liquefied by warmth. As an average solution it is usual to dissolve it in ten to twelve times its weight in water, for making photographic films.

It is practically permanent if kept dry, but if slightly moist it becomes mouldy and decays. It is not possible to introduce any of the cresylic compounds to prevent mildew, as they would destroy it.

Vegetable and many mineral pigments can be mixed with it without injury. When dry it can be washed with turpentine.

It hardens on exposure to air; and hardening may be increased by mixing it in solution with any of the chromates or bichromates of potassium sodium and ammonium. This action is taken advantage of in exposing such a dry film under a negative or positive to daylight or electric light, and immediately afterwards washing away all surplus chromate or bichromate. In this exposure it is highly probable that the chromate or bichromate has altered the chemical character of the gelatine into a compound of a fatty acid which is capable of taking printing ink.

MERCURY.

Mercury—quicksilver (Hg)—occurs in small quantities naturally, but is generally obtained from cinnabar, mercury sulphide, by roasting and catching the vapour.

It is one of the heaviest metals, and the only one which is liquid at ordinary temperatures. It can be boiled at 674°F. or 357°C. It does not tarnish in air. It combines directly with chlorine, bromine and iodine. Hydrochloric acid does not attack it. On heating with sulphuric acid it forms mercuric sulphate. Nitric acid attacks it and forms mercury nitrate. Mercury solutions deposit mercury on iron and copper.

Mercuric chloride—corrosive sublimate ($HgCl_2$)—is formed by mixing mercuric sulphate and sodium chloride. It is very poisonous. It is soluble in water, and when metallic iron or copper is dipped in it, the mercury deposits.

PETROLEUM.

Petroleum, earth oil, rock oil, naphtha, mineral oil, paraffin oil, are the names given to various inflammable liquids found in many parts of the earth. They vary in thickness from specific gravity of 0.5 to 1.1.

Paraffin is a solid substance which occurs in its solid form in coal and bituminous rocks, and is known as fossil wax, ozokerite, etc., but it also occurs in the mineral oils (petroleum). It is occasionally sold in error for bees' wax (which is a true fatty wax).

From petroleum are made gasoline, kerosene, benzoline, naphtha, vaseline, petroleum jelly, paraffin wax, and petrol which should have a special gravity of 0.7.

All mineral oils are a compound of carbon and hydrogen—like turpentine—and cannot be considered as fats or used chemically in place of fats or fatty oils. The petroleum lubricating oils are straight mineral oils.

The extreme thinness of petroleum and its power to dissolve fats and oils make it very useful for removing printing inks. Its power may be increased by the addition of Izal oil, cresylic acid or carbolic acid.

SODIUM SILICATE.

Sodium silicate—water glass, soluble glass—is an indefinite mixture produced by fusing sand and sodium carbonate with a little charcoal, and finally extracting it by water.

It can be decomposed by any acid. It may be used in cheap soap.

In using it for a substratum on glass or metal, mixed with sour beer (acetic acid) it is probable that silicic acid is partly

liberated and forms a surface compound with glass, zinc or aluminium, thus assisting to prevent the sensitized and developed film from peeling off. Potassium silicate may be used instead of sodium silicate in the substratum composition.

TURPENTINE.

Turpentine when distilled from the sap of pine trees has an average formula $C_{10}H_{16}$ and its specific gravity varies from 0.86 to 0.88. There are varieties from America, France, Germany and Russia. The first three are very similar, but the Russian is much thicker and has a disagreeable and persistent odour. Venice turpentine, extracted from the larch, is usually very thick and brown, and dries slowly. All these turpentines may be considered as liquid resins, especially as in distilling the ultimate residues are resins and resin pitch. Sometimes turpentines are adulterated with petroleum and resin oils.

Turpentine burns and the soot is known as essence black. Turpentine is sparingly used to adulterate other essential oils. It is a ready solvent of fats and fatty oils, and resins—much more so than petroleum. Its solvent and penetrating power is increased by the addition of Izal oil, cresylic acid or carbolic acid.

Turpentine may be considered as the leading variety of the whole class of terpenes. The terpenes include the essential oils known as scents, such as bergamotte, camphor, lavender, eucalyptus, geranium, lemon, peppermint, otto of roses, cinnamon, bitter almonds, cloves, thyme, cade, patchouli, cubebs, galbanum, angostura, jasmin, limes, neroli, and oil of winter green; juniper, yew tree, carraway, chamomile, mustard, pepper, hyacinth, violets, citronella.

Some of these are used in pomades, wax varnish and similar bodies to assist in penetration and in drying by evaporation. Some may be used in turpentine substitutes. If more of them were available in quantity in commerce, they could be used in place of turpentine.

Of the turpentine substitutes fit for use in printing operations may be mentioned Yew-tree Wash made by Messrs. Hughes & Treleaven, of Duke Street, Liverpool; turps. substitute by Treleaven & Son, George Street, Liverpool, and Decco turps. made by Clico Petroleum, Ltd., West Ham, London.

Turpentine substitutes are also made by Price's Candle Co., Battersea; Medina Refinery, Ltd., Deptford; Cleveland Petroleum Products, Manchester.

XYLOL.

Xylol is produced from toluene, or methylbenzene (C_7H_8), which, with benzene, are the two lightest "oils" or vapours which are the first products in coal-tar distillation. They are known as "90 per cent. benzol," and toluol. Toluene boils at 230°F. or 110°C. It is a thin colourless liquid with the smell of benzene.

The boiling point being so high, it is not likely to be inflammable in any temperature in a printing room, where 80°F. is considered a maximum; but open gas lights cannot be used, only the coolest electric lights are available.

Xylene or Xylol is dimethylbenzene ($C_8 10_{10}$) a colourless volatile liquid.

Its forms are: Orthoxylene, boils at 284°F., 140°C., from a toluene compound; metaxylene, 278.6°F., 137°C., from xylic acid and lime; paraxylene, 276.8°F., 136°C., from a toluene compound.

Such liquids will thin an ink to a very fine working consistency.

CHAPTER XV.

RECIPES.

I. FOR CLEANING NEW PLATES BEFORE GRAINING.

ALUMINIUM.

1. Immerse in bath of nitric acid 1, water 2;
or 2. Immerse in bath of nitric acid 1 gal., water 2 gals., alum ½ lb.;
or 3. Remove the scale with pumice powder, immerse in bath of caustic potash, and rinse well. Then immerse in bath of either:—
4. Strong nitric acid, hydrofluoric acid, water;
or 5. Strong nitric acid, sulphuric acid, water;
or 6. Strong nitric acid, hydrochloric acid, water.

ZINC.

7. Immerse in bath of sulphuric acid 1, water 100;
or 8. Caustic soda 1 lb., water 1½ gals.;
or 9. Nitric acid 1, water 100.

II. FOR CLEANING OLD WORK FROM PLATES.

ALUMINIUM.

Wash off the ink with benzine or turpentine and carbolic acid, and immerse in a bath of:—

10. Nitric acid ... ... 1 gal.
Water ... ... 2 gals. or 3 gals.

Wash off ink with turpentine or petroleum, with pumice powder rubbed with a felt pad, and follow with wash of benzine; then immerse in the above, and finally re-grain the plate.

ZINC.

Wash off old work with petroleum, benzine or turpentine. Treat with, or immerse in bath of:—

11. Caustic soda ... ... 1 lb.
Water ... ... 1½ gals.
or 12. Caustic potash or lye ... 1 lb.
Water ... ... 20 lbs. (2 gals.)

After treatments 11 or 12, re-grain the plate.

If the grain left be good enough for the work to be next put on it may be treated with a mixture of:—

13.	Nitric acid	4 ozs.
	Alum	1 lb.
	Water	2 gals.
or 14.	Alum	5 ozs.
	Boiling water ...	...100 ozs.
	Nitric acid	1 oz.

Or use the weaker mixture:—

15.	Nitric acid	4 ozs.
	Alum	2 lbs.
	Water	4½ gals.

Well wash and use again.

III. GRAINING PLATES.

ALUMINIUM AND ZINC.

Use fine pumice powder, or fine sand, or ground glass, or fine flint.

By hand method use rubber of felt for aluminium; zinc or stone muller for zinc.

By machine method use glass, porcelain or wooden balls.

For hand graining of zinc use sand sifted through 150 or 160 sieve.

The balls for graining may be varied from ¾ in. diameter for fine grain to 1½ in. for medium grain, and 2 in. for coarse grain.

For a plate 30 in. × 40 in., with balls ½ in. diameter, the number of balls may be 7,000.

IV. SENSITIZING GRAINED PLATES AFTER THE GRAINING PROCESS.

ALUMINIUM.

Rinse well with water, and immerse for a few minutes in:—

16.	Nitric acid	1½ ozs.
	Alum	5 ozs.
	Water	1 quart
or 17.	Nitric acid	10 ozs.
	Alum	1 lb.
	Water	2 gals.

ZINC.

Rinse well, and treat with:—

18. Alum ... ... 1 lb.
Boiling water ... ... 2 gals.
Nitric acid ... ... 3 ozs.
or 19. Nitric acid ... ... ½ lb.
Alum ... ... 2 lbs.
Water ... ...720 lbs. (4½ gals.)

ALUMINIUM AND ZINC (*Patent* 10,049, 1899).

20. Immerse in solution of aluminium sulphate and nitric acid, and pass electric current through the bath;
or 21. Immerse in bath of acid sulphate of aluminium, potash alum, nitric acid, phosphoric acid, water.

V. FINAL TREATMENT OF PLATE BEFORE DRAWING OR TRANSFERRING.

ALUMINIUM.

Roll or compress the plate, to get a finer or coarser grain.

Roll to flatten the points of the grain (Patent 17,647, 1897).

Plates should always be freshened with pumice powder and felt dabber.

Treat the plate with a wash of:—

22. Bi-carbonate of soda ... 1
Pure water 30

ZINC.

23. Well rub the surface with tissue paper;
or 24. Rub well with powdered Bath brick and felt pad;
or 25. Rub well with powdered pumice and felt pad.

VI. TRANSFER INK.

ALUMINIUM.

A good stiff ink, made of:—

26. Litho. printing ink ... ... ½ lb.
Litho. transfer ink ... ... ½ lb.
Calvert's carbolic acid No. 5 5 drops per lb.

And pull the transfers firm.

ZINC.

27. Good lithographic transfer ink; and pull the transfers firm.

VII. RESISTS.

ALUMINIUM AND ZINC.

28. Finely powdered resin and finish off with talc. This lifts the loose particles of resin from the plate.
29. Pulverized sensitive bitumen or asphaltum.
30. Pulverized dragon's blood (Sanguis draconis—from Calamus palms; pterocarpus draco, and Dracœna draco).

ETCHES.

The word etch usually indicates a corrosion. But in the case of zincography and aluminography, it refers to a chemical action upon the ink, rather than upon the plate, in the case of the first etch applied to new work. In all etches containing gum, add a few drops of Calvert's Carbolic No. 2 to each pint.

VIII. FIRST ETCH. (FOR ORIGINALS).

ALUMINIUM.

31.	Gum solution	12
	20% solution phosphoric acid	1
or 32.	Gum water (Baumé 15°)...	70
	Syrupy phosphoric acid (Baumé 45°) ...	1

IX. SECOND OR FINAL ETCH.

33.	Gum solution	8
	20% solution phosphoric acid	1
or 34.	Gum water (Baumé 10° to 12°)	30
	Syrupy phosphoric acid (Baumé 45°) ...	1
or 35.	L-AN-B No. 3 powder	5 ozs.
	Water	1 gal.

X. FIRST ETCH. (FOR ORIGINALS).

ZINC.

Prepare a solution of potassium bichromate 1 oz., in water 20 ozs.

36.	5% solution potassium bichromate	½ pt.
	Gum solution	½ pt.
or 37.	Gallic acid	1 oz.
	Gum solution	12 ozs.
	Phosphoric acid	½ oz.
or 38.	"Zetch" solution	
or 39.	L-AN-B	2 ozs.
	Water	35 ozs.

or 40.	Gum solution	8
	Phosphoric acid	2
	Gallic acid	2

Prepare a solution by soaking 1¼ ozs. to 1½ ozs. gall nuts in 1 pint of water. After 24 hours, boil the solution; allow to cool and strain off;

or 41.	Gall nut solution	1 pt.
	Gum solution	½ pt.
	Phosphoric acid	½ oz.
or 42.	Gall nut solution	¾ pt.
	Ordinary gum solution	¼ pt.
	Phosphoric acid	2 drs.
or 43.	Phosphoric acid (sp. gr. 1.5) ...	1
	Gum solution	60

XI. SECOND OR FINAL ETCH. (ETCH FOR TRANSFERS).

44.	Gallic acid	1 oz.
	Phosphoric acid	½ oz.
	Gum solution	1½ pts.
or 45.	The gall nut etch No. 64 or 65 of about half strength;	
or 46.	L-AN-B No. 1 powder	5 ozs.
	Water	1 gal.
or 47.	"Zetch" solution.	

In making etches it must be remembered that as water is repelled by grease, when an etch is made of water and acids, or even a very watery solution of gum, that the grease on the plate will repel such an etch and leave a halo of light all along the margins of the work. The actual edges will therefore be insufficiently etched, and ultimately have a feathered appearance. By using thicker gum solution, the adhesive of the gum will resist this repulsion, and will assist greatly in efficient etching. All etches, therefore, must be kept continually in motion on the plate to prevent this defect, except on original chalk drawings.

XII. ETCH FOR GIVING RELIEF.

48.	Alum	50
	Water	10
	Nitric acid	15

The well-rolled-up plate, dusted with resin and talc and warmed, is placed in a rocking bath and etched from 4 to 12 minutes. Remove, wash, wipe and dab out any

water and sediment; apply an ordinary second etch for zinc and leave on 5 minutes. Rinse well, wipe and dab dry and gum up well. After one hour's rest, wash out with Cornelian tinktur ("doctor"), fan dry, and proceed to prove.

XIII. "DOCTORS."

The washing-out fluids, which have been in use many years, were originally applied much in the way the doctor gave physic to a weak patient. The term "doctor" was applied at least twenty years ago, probably more, and as it is a convenient expression is adopted in this treatise for all the special washing-out or strengthening fluids.

RECIPES.

49. Add artists' crayons to turpentine to make a saturated solution;

or 50. Turpentine 1 pint, in 1½ pint bottle, add crayon parings until it will not dissolve any more. Strain off the liquid and add to it sensitive bitumen or asphalt, 1 oz.;

or 51. Similarly saturate 1 pint of turpentine with beeswax; strain and add 1 oz. bitumen;

or 52.	Jew's pitch powder	100 grammes
	Rectified benzine	200 grammes
	Essence of turpentine	800 grammes
	Draughtsman's ink	½ stick
or 53.	Asphaltum powder	½ lb.
	Benzole	⅓ pint
	Yellow wax	2 ozs.
	Tallow	¼ lb.
	Oil of lavender	1 oz.
	Turpentine	2 pints
or 54.	Yellow wax	150 parts
	Venice turpentine	200 parts
	Oil of tar	50 parts
	Black litho-printing ink	250 parts
	All well melted, then add:—	
	Pulverized asphalt	500 parts
or 55.	Asphaltum	2 ozs.
	Stearin	1 oz.
	Beeswax	1 oz.
	Oil of lavender	10 ozs.
	Re-transfer ink	2 ozs.
	Turpentine	20 ozs.

or 56.	Syrian asphalt	400 grammes
	Oil of turpentine, or polish turps.	400 grammes
	Rectified turpentine, French ...	150 grammes
	Litho. varnish	25 grammes
	Anhydrous benzol (benzine) ...	40 grammes
	Yellow wax	20 grammes
or 57.	Asphalt	500 parts
	Yellow wax	125 parts
	Talc	125 parts
	Oil of lavender	20 parts
	Turpentine	3,000 parts

NAMES OF "DOCTORS" MANUFACTURED FOR SALE.

Washing-out liquids sold by dealers in zinc and aluminium plates:—

Bringupine (Hughes, Treleaven & Co.)
Phirmold (Lowe & Brydone.)
Mogul (Penrose & Co.)

XIV. RE-SENSITIZING FOR CORRECTIONS.

ALUMINIUM.

After taking out the work with concentrated sulphuric acid, rinsing and drying, treat with:—

58.	Saturated solution of oxalic acid ...	20
	Water	96
or 59.	Saturated solution of oxalic acid ...	4
	Sulphuric acid	4
	Distilled water	90
or 60.	Saturated solution of oxalic acid in sulphuric acid	10
	Water	90

ZINC.

61.	Nitric acid	¼ oz.
	Alum	1 oz.
	Water	1 qt.

Follow with powdered whiting, rubbed with a felt stump and a little water ;

or 62. Weak solution sulphuric acid.

63. If new ink work is to be eradicated, rub it off with india-rubber, or ink eraser, or take it off with brush and benzine.

XV. SET-OFFS.

Use a fine hard glazed brown paper, or a fine flint, or steel blue paper.

ALUMINIUM AND ZINC.

64. Aniline colour and magnesia,
or 65. Mixture of sienna, Frankfort black, } see page 55.
or 66. Sienna, bronze blue.

If the first be used, a very thin wash of turpentine should be given to the plate.

67. "Paramount" (Horsell & Co.'s) permanent offset powders;
or 68. Renova or Standphast permanent offset powders.

XVI. TO KEEP PLATES CLEAN IN PRINTING.

ALUMINIUM.

69. Weak solution of bicarbonate of soda;
or 70. L-AN-B No. 4 powder 1 lb., warm water 1 gal.

Or for plate edges:—

71. Saturated sol. oxalic acid	4
Nitric acid	4
Distilled water	90

Or for obstinate patches of dirt rub with:—

72. Sienna powder	1
Sulphuric or oxalic acid	2

or 73. Occasional treatment with "Zetch" solution.

ZINC.

By adding to damping water:—

74. Strong solution of tea.
75. Gum solution.

Make stock solutions of:—

76. 16 ozs. chromic acid in 16 ozs. water.
4½ ozs. phosphoric acid (85%) in 11½ ozs. water.

Take 1 oz. of each and add to 16 ozs. gum solution, and use about 1 oz. of this to a gallon of the damping water.

CHAPTER XVI.

TREATMENT OF ZINC BRIEFLY TABULATED.

NEW POLISHED PLATES.

1. Immerse in caustic soda bath.
2. Wash; dry.
3. Grain in mechanical grainer; wash and dry.
4. Immerse or treat with nitric acid, alum, water.
5. Wash, dry, then

DRAW ORIGINAL WORK, INK AND CRAYON.

6. Etch: potassium bichromate and gum (1st etch).
7. Wash off with gum water; dry.
8. Gum thinly and evenly; dry.
9. Wash out with "doctor" or turpentine.
10. Roll up solid or not, if "doctor" has been used.
11. Wash off gum and ink with clean rag.
12. Roll up in good ink; dust with talc.
13. Etch: potassium bichromate and gum.
14. Wash off; dry; gum up; dry.
15. Wash off gum and prove.

TRANSFER ON ZINC.

16. Gum up; dry.
17. Wash out with "doctor" or turpentine.
18. Roll up solid or not, if "doctor" has been used.
19. Wash off gum and ink with clean rag.
20. Roll up in good ink; dust with talc for etch.
21. Etch with No. 76 recipe, or "Roderzone."
22. Wash off; dry; gum up; dry.
23. Prove.

ADDITION ON ZINC.

24. Wash off gum; roll up stiff; dust with talc.
25. Wash with nitric acid, alum and water.
26. Scrape whiting on, sprinkle with water and rub with felt stump two or three minutes.

27. Wash off clean; make new drawing or transfer.
28. New drawing treat as 6–15.
29. Transfer treat as 16–23.

ALTERATION ON ZINC.

30. Wash out part to be altered with turpentine, on the dry gum. When alteration is small, omit the turpentine wash-out.
31. Treat same place with strong caustic, potash or lye.
32. Prepare with weak sulphuric acid or as 25 above.
33. Treat with whiting as 26.
34. As 27, 28, 29.

REMOVING WORK FROM PLATE.

35. Wash with turpentine.
36. Treat with caustic soda.
37. As 2, 3, 4, 5.

TREATMENT OF ALUMINIUM BRIEFLY TABULATED.

NEW POLISHED PLATE.

38. Immerse in nitric acid, alum, water.
39. Wash; dry.
40. Grain in machine.
41. Immerse in nitric acid, alum, water.
42. Thoroughly wash.
43. Wash; dry.
44. Rub well with pumice and felt pad, then DRAW ORIGINAL WORK, INK AND CRAYON.
45. Dust well with rosin and talc; warm the plate.
46. Etch with phosphoric acid and gum (1st etch).
47. Wash off and gum evenly and dry.
48. Wash out with "doctor" on dry gum.
49. Wash off gum and film of "doctor."
50. Roll up with stiff ink; dust with resin and talc.
51. Etch with phosphoric acid and gum.
52. Wash off; gum thinly; dry.
53. Prove.

TRANSFER ON ALUMINIUM.

54. Rub well with pumice powder and felt pad, or 25 if an old plate.
55. Treat with carbonate of soda solution.
56. Put down the transfer; wash off with warm water.
57. As 47–53.

ADDITIONS ON ALUMINIUM.

58. Wash off gum; roll up stiff; dust with talc.
59. Prepare with No. 58 recipe.
60. Wash off; dry.
61. Draw or transfer the addition.
62. New drawing treat as 45–53.
63. New transfer treat as 47–53.

ALTERATION ON ALUMINIUM.

64. Wash off gum; roll up stiff; dust with talc.
65. Remove work with concentrated sulphuric acid.
66. Wash off clean.
67. Treat with nitric acid, alum, water and follow with whiting or recipe 59.
68. As 60–63.

REMOVING WORK FROM PLATE.

69. Wash off work with turpentine or petroleum.
70. Rinse well with water.
71. As 38–43.
72. Rub over any plate, new or old, with pumice powder and felt pad, before use, if preferred to the wet preparation, as 67.

Note.—In all cases when a plate has been prepared for alterations, all the work should be dusted with talc to protect it and prevent smearing.

CHAPTER XVII.

PHOTOGRAPHY UPON ALUMINIUM AND ZINC.

The use of metal plates for direct photographic work has increased so largely that it is necessary to enter fully into the photographic methods of obtaining originals upon metal plates. It is not, therefore, intended to deal with cameras and the production of the cross-line negatives by screens. Such negatives will be considered as a part only of the semi-mechanical methods. In the main the trend of this chapter is producing photographic printing plates without a camera. In all cases it will be assumed that the craftsman has a negative or positive on glass, celluloid film or paper, and if the subject has to be reduced or enlarged it will be possible to obtain the reduced or enlarged negative or positive from some photographer. The work described here will be such as can be done within the printing works where the necessary plant is installed. And to lead up to the highest class work, the Vandyke process is the most convenient starting point.

In all cases where the copy is to be used, it should be upon paper which is reasonably translucent, and the drawing, writing or print, must be quite opaque.

VANDYKE'S PROCESS, THE VANDYKE PROCESS, OR TRUE TO SCALE.

The name by which this process is known is more or less unimportant. The names do not indicate its nature, but one gives an idea only that it is to produce work true to scale of the copy. It originally meant that plans and drawings could be produced exactly to copy, but to the process craftsman it is capable of a much wider application.

In introducing this method it must be noted that extra appliances are necessary, that the apparatus must be large enough for machine plates in many cases and that the manipulation and chemicals require much closer attention than in photo-lithography.

In this method the sensitive film is spread on the zinc plate; the composition of the film is such that it will dissolve in water to some extent—quite unlike the film on photo-litho transfer paper. The sensitized zinc plate is exposed under the copy, or negative, in a photo-printing frame, and the result is an original on plate—machine plate if required—ready for printing.

For the purpose of easy reference the method will be dealt with in separate sections.

(1) THE ZINC PLATE.

For offset printing use a fine grained plate suitable for the machine, and give it a preliminary freshening or cleaning with pumice powder and a felt pad, or a wash over with a mixture of:—

Alum	1 oz.
Water	40 ozs.
Nitric acid	½ oz.

Then wash off well and dry quickly.

(2) SENSITIZING THE PLATE.

The plate having been dried is placed in a whirler.

The sensitizing film should be made up of:—

Fish glue	1 oz.
Water	6 ozs.
20% ammonium bichromate sol. ...	2 ozs.
10% chromic acid sol.	5 minims.

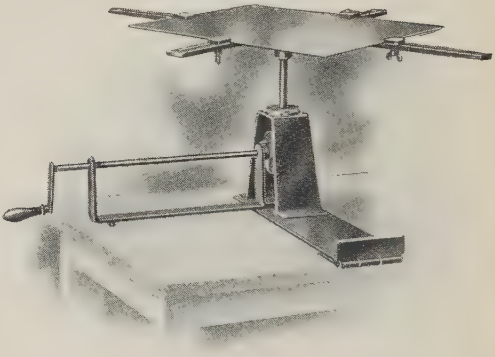
For finer work the solution may be strengthened with albumen, as follows:—

Fish glue	2½ ozs.
White of	half an egg.
Water	5 ozs.
Ammonium bichromate	60 grains

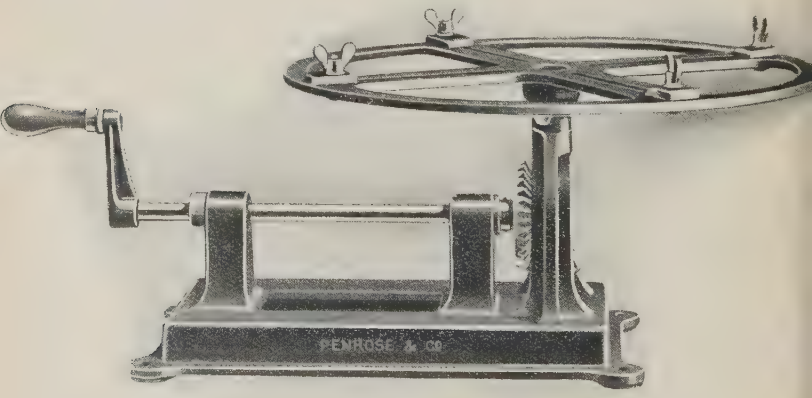
The operation of sensitizing must be done in a non-actinic light—in a dark room, illuminated by orange or canary yellow light. The film is poured on the damp plate mounted on the whirler, and steadily rotated to obtain an even thin film. Too much speed will leave the centre almost bare.

After coating, the film may be dried over a gentle heat, watching carefully that no burning or baking takes place. This must be done in the dark room, where it may then be put in the printing frame with the copy, ready for exposure.

Hand Whirler.
Hunters Ltd.



Reversing Whirler.
Hunters Ltd.



Simple Whirler. A. W. Penrose & Co., Ltd.

Plates small enough to handle may be coated by hand. The plate is damped and the solution is poured along the near edge (between the operator's hands); it is gently tilted to allow the film to spread all across the plate. As it does so it drives the moisture off at the far edge. Then turn the plate completely round, add more film and allow it to run across. Finish off on the whirler, and dry it.

PRINTING-DOWN FRAME, OPEN FOR ARRANGING NEGATIVES.
A. W. PENROSE & CO., LTD.

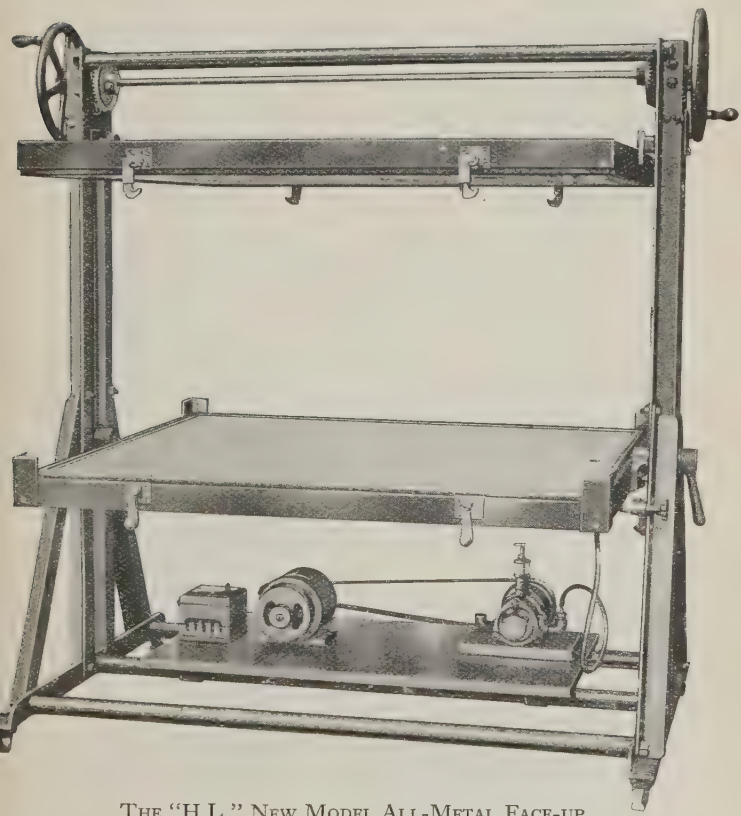
To pour the film on the plate put the solution in a wide-mouthed bottle and cover the mouth with fine muslin. This prevents air-bubbles, when pouring the film on the plate.

(3) THE EXPOSURE, AND THE COPY.

(*a*) In the first example, the work to be copied may be a plan, or architects' or engineers' drawings upon drawing paper. The printing frame should be large and may be of the structure shown. There are other forms, less expensive, which are efficient for this work, but if the object is to go in for the whole range of photo-process work for offset then by all means purchase the best printing frame in the market. From recent experience the frame should be of the type which is mounted horizontally over the lighting chamber or reflectors. As an instance of this form of printing apparatus may be mentioned that shown at the "Typary and Typon" practical demonstration studio, at the late Printing Trades' Exhibition. The printing frames for making up printing plates have been considerably improved and modified to meet the various purposes to which they have to be applied. From past experiences it is considered that all such frames should be arranged to lie horizontally for arranging the negatives or paper copy and sensitized metal plate. Such a frame made by Messrs. Penrose & Co. is shown in the illustration, with the plate glass half of the frame opened upwards to allow all the manipulation of sensitized plate and the various negatives or paper copy on the rubber sheet of the vacuum producer. This rubber sheet is supported by a spring mattress, which prevents any movement of the negative when clamping the glass down. The whole frame is turned to the vertical position, after the vacuum has been made, and the exposure is given, to electric lights. It can be fitted with spring blinds to mask out any part of the sensitized plate. It is made in three sizes:—48 × 40 in., 66 × 50 in., 80 × 56 in.

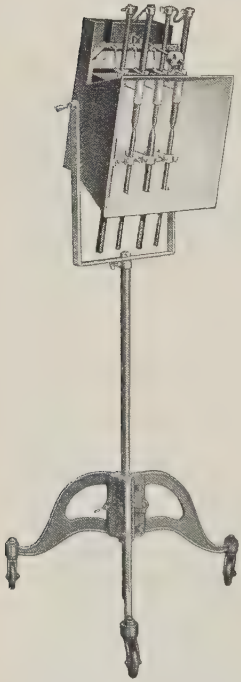
They also make a light, portable frame of a similar type; being the all-metal "face-up" vacuum frame, light pattern, which is convenient and simple in working. The glass frame is hinged at the back, and when raised leaves the plate frame supported horizontally on the stand, which is fitted with castors. The vacuum is produced by foot pump. It is made in six sizes, for plates of 25 × 20 in. up to 63 × 49 in.

The "H.L." All-Metal Face-up Photo-Litho. Printing-down Frame is constructed to permit of the glass front being raised out of the way of the operator to give ample head room for him to lay the negatives or paper copies on the sensitized plate. After setting out, the glass frame is lowered by the side gear in each standard and clamped easily to the lower

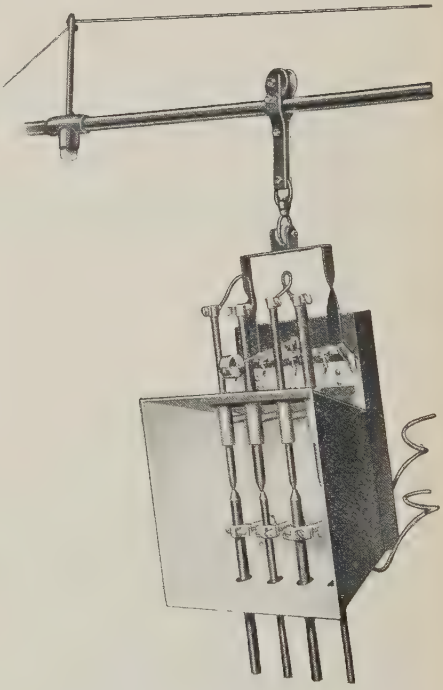


THE "H.L." NEW MODEL ALL-METAL FACE-UP PRINTING-DOWN FRAME. HUNTERS LTD.

frame. The vacuum is made, and the whole frame turned almost upright for exposure to the electric light. Such lights may be of the eight-carbon type also made by Hunters Ltd.



The "H.L." 8-Carbon Arc. Hunters Ltd.

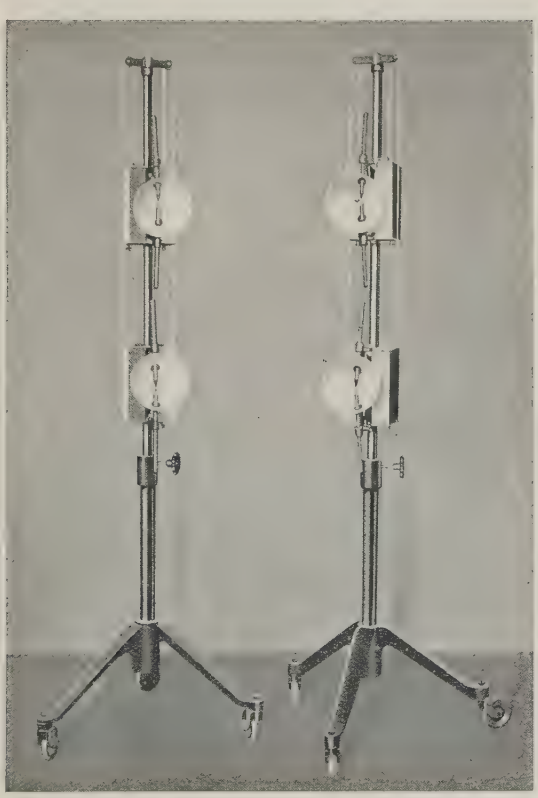


The "H.L." 8-Carbon Arc. Hunters Ltd.

It is advised that during exposure the motor exhaust should be kept going to insure constant contact, but if due precautions are taken regarding cleanliness of glass and rubber beading, and the latter be occasionally treated with glycerine, the frame will maintain perfect contact for many hours with the exhaust equipment switched off.

These frames can be obtained with the masking blinds, for exposing to one negative, then re-setting the negative any number of times and exposing each time until the requisite number has been obtained.

These frames are made in three standard sizes, viz., 50 × 43 in., 65 × 45 in., and 71 × 56 in.

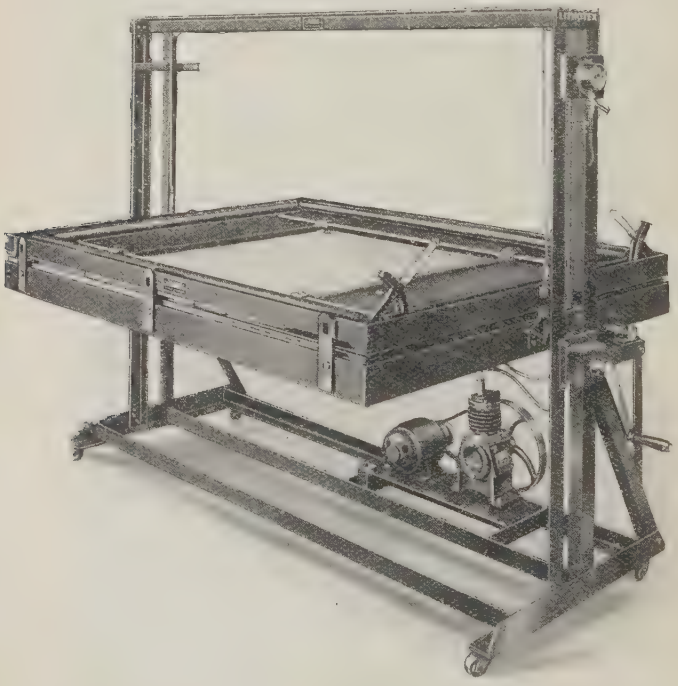


"Empire" Arc Unit, showing Four Lamps.
A. W. Penrose & Co., Ltd.

"LITHOTEX" PRINTING-DOWN FRAME.

Illustration shows the "Lithotex" Printing-down Frame, made by Pictorial Machinery, Ltd. This now forms the standard equipment of the largest photo-litho. plants of to-day. This frame is built as an "all-metal unit" and is self-contained. The glass is elevated by safety mechanism and is held in shock absorbing buffers. This vacuum contact frame also incorporates a number of special devices to assure its practical operation under working conditions, and is complete with motor and vacuum pump.

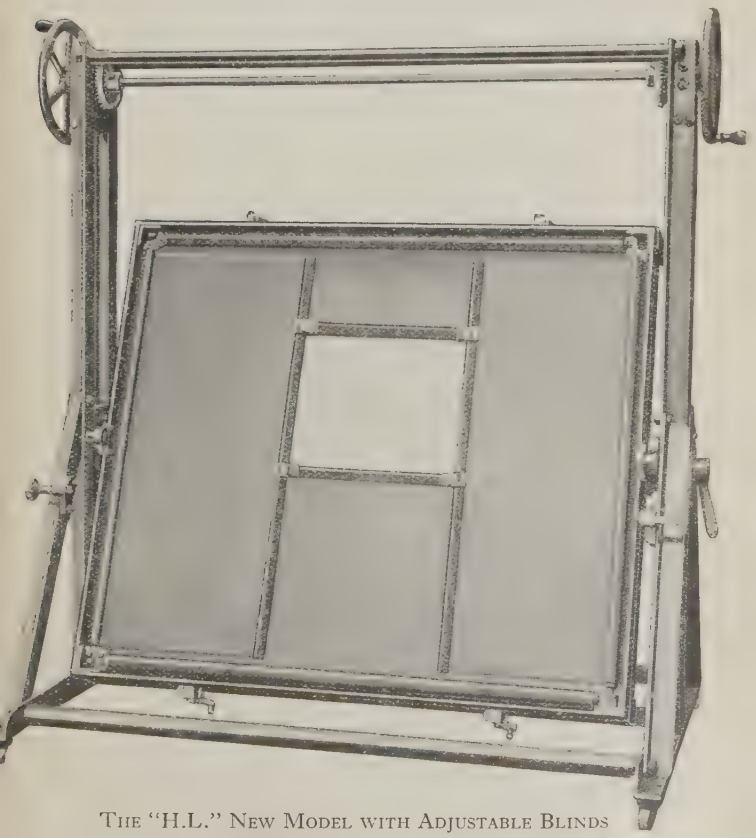
In this and other forms of frames the sensitized plate is laid in the frame, when in the horizontal position, and the "copy,"



"LITHOTEX" EXHIBITION MODEL PRINTING-DOWN FRAME.
PICTORIAL MACHINERY LTD.

in whatever form it may be, is arranged on the sensitized plate. Then the glass top is lowered, locked, and contact obtained by vacuum. Masking-out blinds can be used for a series of exposures.

Any ordinary frame which may be used must have a strong plate glass front. In making the exposure place the copy, which is on one side of the paper only, face down on the plate glass and upon its blank back place the sensitized face of the



THE "H.L." NEW MODEL WITH ADJUSTABLE BLINDS FOR SUCCESSIVE EXPOSURES. HUNTERS LTD.

zinc plate. Upon the zinc place a few sheets of paper, then close the back of the frame by the pneumatic backing and exhaust by the pump to give the closest contact.

The exposure may be timed by using a small printing frame, in which a similar drawing is exposed with the ordinary P.O.P. photographic printing paper behind it. The conditions of lighting must be similar. When this test frame shows the print in the usual depth of tone obtained for photography the exposure is complete and the plate may be removed for the next operation of development. In any case where the paper copy is thick, and may require an exposure of over ten minutes, the copy must be thoroughly dried before placing it in the frame, or it will be liable to shrink owing to the heat from the lamp.

(*b*) As a second example, take as the copy any sheet of printed matter, which is printed on one side of the paper only, such as galley proofs, or press proofs. These must be pulled in a dense black, and should for preference be upon a good paper devoid of cloudiness. But there is no objection to the paper being translucent. In this way whole columns of proofs from composing machines can be patched up in position, on a translucent paper and copied direct on to the offset machine plate. Such copy must be exposed just as already described in the first example, and the exposure timed by the test printing frame with a similar copy in it.

It will be noted that in this process, when used for offset, the copy is placed in the photo-printing frame in the position which, when viewed through the plate glass front, will be seen in its normal reading position, i.e., it will read from left to right. As it is well known that all the matter on an offset plate must be in its normal reading direction, the position of the copy in the printing frame is obvious.

Photographic films are so thin that a photo-print taken from the wrong side is practically the same as if printed correctly, from the right side of the film.

An important point in the use of the sensitive films is that when the copy is a very fine subject the harder film should be used. In the early part of this article three recipes are given. The first is suitable for work which is in good strong lines or dots, the two others are for lighter and finer work which in all subsequent manipulations treat more carefully and tenderly than the coarser work.

"EMPIRE" VACUUM PRINTING BOX.

This form of photographic printing and photographing frame is suitable for all the various applications of the Typon method described in this work (page 161).

It is made by Messrs. Penrose & Co., in five sizes, from 26 × 22 in. up to 48 × 40 in.

"EMPIRE" PRINTING-DOWN AND EXPOSURE BOX PATTERN, WITH VACUUM PUMP. A. W. PENROSE & CO., LTD.

(4) DEVELOPMENT OF THE PLATE.

The plate when removed from the photo-printing frame should be washed at once under a gentle stream of water from the tap, for not more than one minute, or the fish glue will be dissolved too much. From the washing trough place the plate in a ten per cent. sol. of coal-tar violet (say, water 20 ozs., crystal violet 100 grains), for about half a minute, where the whole film will take the stain, but the exposed parts (that is, the negative effect, which is not required) will be darker than the subject. This operation is done for the purpose

of seeing if the exposure has been correct, and that the subject itself is sufficiently perfect to proceed with the plate. If the imperfections are slight and can be drawn in afterwards then continue the development; if, however, it appears to be a badly exposed plate have the plate cleaned, scoured and grained for another effort. Providing that the plate is passable, give it another wash under a stream of water and dry it on the whirler. (*a*) The exposed parts have been hardened just sufficiently to withstand these three wet treatments, but the unexposed parts (that is the subject copied) have been dissolved and are washed away. To finally clean the subject, flood over with a solution of perchloride of iron 45 deg. Baumé, 1 oz., and water 20 ozs., or 2% solution of hydrochloric acid, to clear the metal, then flood with nitric acid-alum-water. This treatment not only cleans the plate where the subject is, but it removes the violet stain. Finally, wash the plate again and dry on the whirler, finishing off over a slight heat. All the breaks and spots in the film and the margins must be stopped out with gum and dried. The plate is then ready to receive the strong greasy ink (similar in character to the "doctor" already mentioned). Suitable ink may be made by dissolving in benzole and turps., bitumen (sensitive) 4 ozs., and lithographic draughtsman's ink 1 oz. This ink is rolled all over the plate, on a hard composition roller, until there is an even thin film all over it. Or pour a quantity of the ink on the plate and with a fine cloth spread it all over the plate. When the ink has been spread all over allow it to sink in, then put on a thin layer of Mogul varnish. (*b*) Then just warm the plate, and allow it to cool and stand by for one or two hours ; proceed to clear off the exposed film (and the film of ink on its surface) by immersing the plate in a solution of 2% acetic acid or the 2% solution of hydrochloric or sulphuric acid may be used. As the plate rests in the bath, rub the film off with a wad of cotton wool. This operation is soon completed. A good wash under the tap and drying on the whirler brings the plate, with the subject only on the plate covered with ink, into the same state as a transfer on zinc and amenable to the same treatment as already described in Chapter VII. Now wash out the work with a strong "doctor," using a soft flannel for this purpose and leave the plate just lightly protected with clean paper for an hour. To bring the plate into the condition for the printing machine,

wash off the gum (and the adherent ink) with a flannel and water. In the usual way, damp the plate with a cloth and roll up in a good printing ink on a nap roller, and dust with talc (to prevent smearing during cleaning up) and remove all specks and other unnecessary matter with caustic potash 3 ozs., in three-quarters of a pint of water, using quill to apply it, following with a gum sponge (frequently washed out to remove the caustic potash). When clean, the plate must be inspected thoroughly, and if there is a tendency to weakness, even in parts only, it must be prepared, touched up, and rolled up, following with talc and etch. Gum up, dry, wash out on dry gum with "doctor," roll up for proving or printing.

The foregoing treatment of zinc plates for this process has been based on the use of fish glue in the sensitizing film. With care it might be successful for fine work such as fine line products, but it might be better to use albumen recipes. In that case only a little difference is necessary in manipulation. Such variations are:—(*a*) After the staining with violet, the surface should be washed over with a solution of one per cent. ammonia, and dry it. This is to remove the "albumen film." Then a wash in cold water will leave the zinc bare. These bare parts may be gently rubbed with wet pad of cotton wool to clear the lines; the perchloride of iron solution may be used for the same purpose, but it has a tendency to remove the exposed film, which should not happen. (*b*) The final clearing away of the exposed albumen film is effected by a two per cent. solution of hydrochloric acid in water. In all other respects the treatment is the same.

Notes.—A standard cleansing solution has been mentioned as acid-alum-water; it may be stated that a suitable recipe is nitric acid 1 oz., alum 5 ozs., and water 100 ozs.

The treatment of work on zinc, which so far has partaken of the nature of transfers, includes an etch—often spoken of as the second or final etch. This etch may be made up by the craftsman by mixing gallic acid 1 oz., phosphoric acid $\frac{1}{2}$ oz., gum solution $1\frac{1}{2}$ pints; but, if to save trouble and at the same time use a reliable made up etch, the article known as Zetch, supplied by zinc plate dealers, can be recommended.

The term "doctor" has been used frequently in the foregoing descriptions, and suitable recipes are:— (1) Saturated solution of lithographic crayons in one pint of turpentine, to which after straining, add one ounce sensitive bitumen. (2) Turpentine 5 ozs., tallow $\frac{1}{4}$ lb., bees' wax $\frac{1}{4}$ lb., sensitive bitumen 1 oz., oil of lavender $\frac{3}{4}$ oz.

In every case where it is necessary to warm a plate while the film is still on the surface, the warmth should not exceed 100 to 105°F. It is better to regard the plate as cold, and as soon as the chill has been warmed off, then the plate may be termed warm. Very little more heat will start to bake the film and destroy the whole of the work.

NEGATIVES—PRINTING DOWN.

In the Vandyke methods described above, particular stress was laid on the point that in each case the copy must be a positive, either as a drawn or printed subject, or as a positive photograph on glass or film or paper. It may be added that the results of that process, even if carefully carried out, are usually less certain than by the use of negatives. The fact that in the development of the Vandyke plate, the plate is cleaned bare where the subject is, and strong ink is filled in on this bare plate, which is much more likely to obtain a strong subject than when the subject exists on top of a film, as it is in the regularly practised method of direct photography on plate from negatives.

The direct method by using a negative copy does not differ very much from the methods described under the Vandyke process. The same care must be taken in the preliminary freshening or cleaning of the plate, before sensitizing.

In making a working plate for offset printing, the negative used must not be reversed, as is customary in making negatives for cross-line and other blocks for letterpress printing. The unreversed negative will give a correct, left to right, positive image on the working plate.

From a consideration of this procedure, it will occur to many who have seen the "Lithotex" method, that the same negative can be printed on to a large printing plate a number of times, at a fixed distance apart. The result being the production of a machine plate with a multiple of originals. As is generally known, such an operation must be conducted under

the proper conditions to exclude daylight. The latest form of the "Lithotex" apparatus is specially made to secure this result.

The sensitizing film may be either of the two containing albumen, as given for Vandyke method. But the following recipes, without fish glue, may be found more effective in most cases. Much depends on the individual user as to which recipe is adopted.

The recipes are:—

	I.	II.	II.
Water	1 oz.	7 ozs.	1000 grains
White of egg	1 egg		
	or		
Dry egg albumen ...	(10 grains)	1 oz.	100 grains
Potassium bichromate	10 grains		
Ammonium bichromate		32 grains	3 grains
Liquor ammonia ...	q.s.	2 or 3 drops	q.s.

In each case the amount of liquor ammonia is determined by watching its effect in changing the colour of the emulsion from a brownish tone to a pale yellow; but it may be added that some experienced craftsmen use liquor ammonia in much larger quantities.

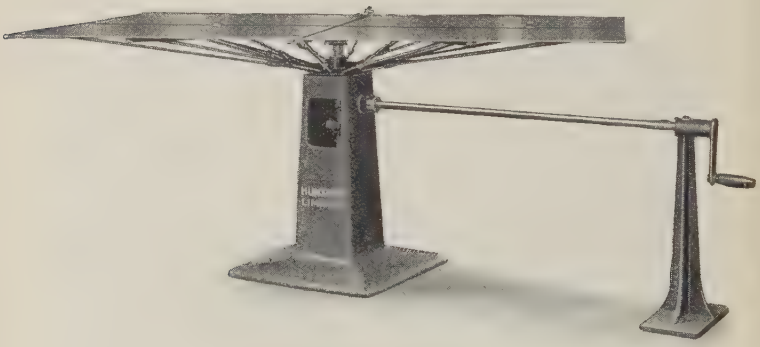
In making the emulsion, the albumen of the egg is put into a bottle with some small pieces of broken glass and the water thoroughly shaken until the albumen is cut up and becomes a workable solution in the water. A very good mixture may be obtained by whisking. This solution is then filtered through cotton wool. The bichromate solutions must also be filtered. The two filtered solutions are then thoroughly mixed and filtered. To this emulsion the liquor ammonia is added until the colour becomes a pale yellow tone.

The emulsion is then poured on the zinc plate.

Pour the emulsion along the short edge, tilt the plate and the emulsion will flow across and drain off at the opposite short edge. Turn the plate to a long edge and again flood the plate. Repeat the operation from the opposite long edge. It is then placed in the whirler. Or the plate may be placed on the horizontal whirler (with its source of heat below), damped, and the emulsion poured on at the centre, and whirled. The whirling must be at a very moderate speed, just sufficient to spread the thin film over the plate. The film is thin, as there should only be from six to ten drops

(minims) to the square inch. One drachm should cover six square inches, or two ounces for a surface of ten inches by twelve inches. The speed of whirling depends on the density or consistency (viscosity) of the film emulsion. It may vary from 80 to 500 revolutions per minute.

This simple form of whirler in use for years past has been in general principle maintained, but has been elaborated in strengthening the construction to support plates of 64 × 46 in., and in all cases the whole whirler should be surrounded by a thin metal casing to catch any spray of film driven off by the rotation. An important addition has been by introducing either gas jets or a long row of electric heaters. The

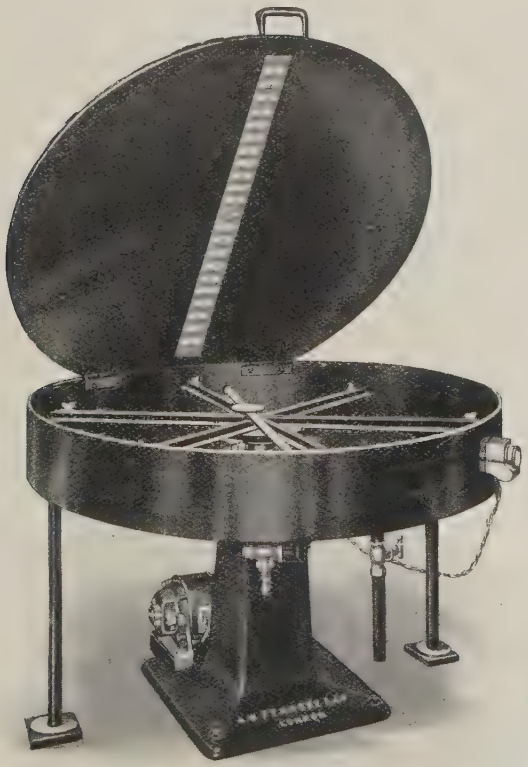


The "H.L." Photo-Litho. Whirler.
Hunters Ltd.

gas jets may be arranged on a flat tube which is placed across under the plate, the full length of one diameter. Such an arrangement has been well tried and found satisfactory. However, to avoid the inconveniences of fire and fumes, the heating should be obtained from a bar of electric heaters acting above the plate. In the Penrose Empire Electric Whirler, the bar of electric heaters is supported under a complete lid over the whole whirler, and brought down by the lid to within an inch or so of the plate which is receiving the film. The lid prevents dust specks. The mechanism

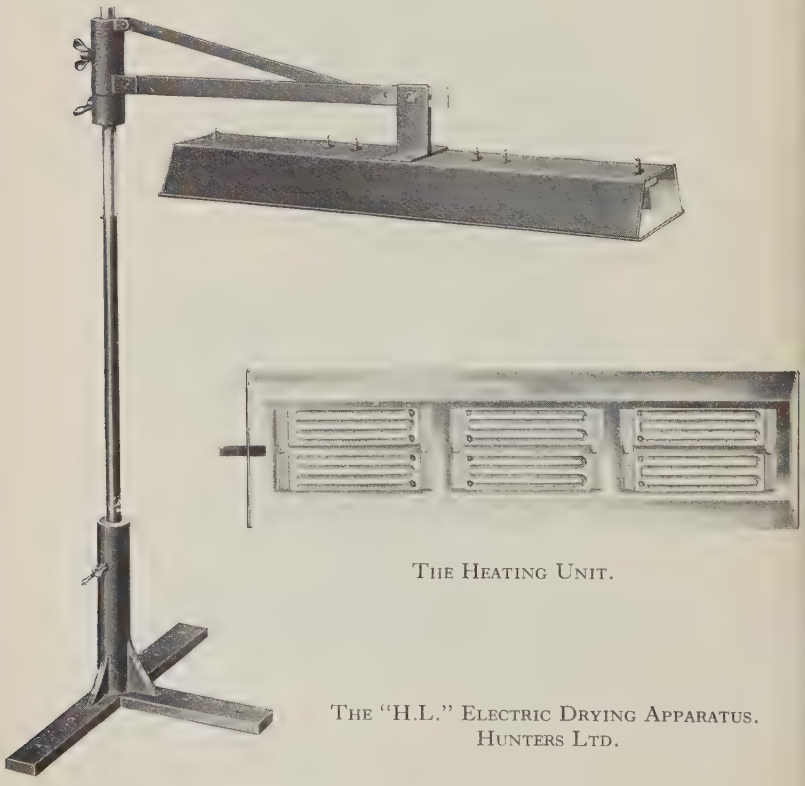
is all run on ball bearings, and a self-contained water supply ensures cleanliness. It is made in four sizes for plates 42 × 32 in. to 65 × 49 in.

The "H.L." Photo-Litho Whirler made by Hunters Ltd., St. Bride Street, London, is constructed to obtain an



"Empire" Electric Whirler, with Electric Drying Unit.
A. W. Penrose & Co., Ltd.

absolutely horizontal plane upon which the plate will rest and be secured. The supporting plate is galvanized iron, made in four sections and supported on tension rods from the revolving spindle. Each rod can be independently adjusted by a double-ended lock nut. It can be driven by hand or geared for belt or motor drive. It should be surrounded by a thin metal casing or guard to catch the spray of film during rotation. Such guard may be covered by a lid. The



THE HEATING UNIT.

THE "H.L." ELECTRIC DRYING APPARATUS.
HUNTERS LTD.

drying may be effected by a row of gas jets below the table, or by the bar of electric heaters suitably supported over the plate.

Drying by electric heaters should avoid the over-heating of the tension rods and iron plate, as when gas is used. Further, electric heating properly applied should assist in giving the uniformity so necessary for the proper activity of the film. The heating is arranged so that at the centre it is a minimum and gradually increases towards the outer edge.

The distance of the heater from the plate can be regulated by the locking collar on the standard. In making the connections, switches may be attached to connect the whole of the heating elements, or for controlling each pair of elements separately. The current consumption is for double demy size, 1,400 watts (1.4 amperes); quad demy size, 2,400 watts (2.4 amperes); eight-crown size, 3,400 watts (3.4 amperes). The average time for drying a coated plate is $4\frac{1}{2}$ minutes.

Messrs. Hunters Ltd. make a simple whirler for use on the bench for plates up to 15 in. square, and 20 in. square. They provide also a hand whirler for plates up to 15×12 in. In this apparatus the bulb should be moistened with water when in use.

Messrs. Hunters Ltd. recommend the following sensitizing solution:—

Egg albumen powder	...	...	5 ozs.
Ammonium bichromate (pure)	...		$1\frac{1}{4}$,,
Liquid ammonia .880	...	...	$1\frac{1}{2}$,,
Water		...	80 ,,

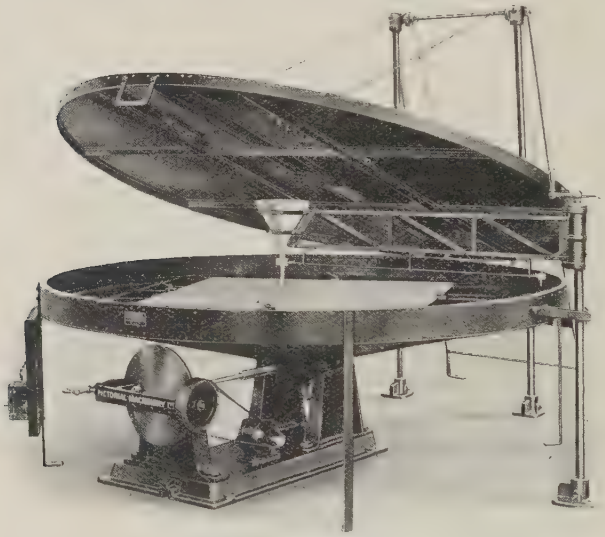
which with a clean line negative requires an exposure of four minutes under the following conditions:—

(*a*) The solution 1 to 4 days old.
(*b*) The solution flowed over the plate twice, and the plate allowed to drain for 10 to 15 seconds.
(*c*) The plate whirled at a speed of 90 to 100 r.p.m.
(*d*) The source of heat so adjusted as to dry the plate in 4 to $4\frac{1}{2}$ minutes.
(*e*) One "H.L." Eight-carbon Printing Arc Lamp distanced 22 inches from the plate.

"LITHOTEX" SUPER WHIRLER.

This whirler is designed and constructed by Pictorial Machinery, Ltd., to work in conjunction with their "Lithotex" frames and "Printex Junior" machines. It is

in itself a plate preparing, coating, developing and washing machine. The low circular tray is water-tight and fitted for the water supply and drain. The whole is covered by a lid to exclude dust, while the drying is effected when the lid is closed by means of heat units and electric fan which produce the necessary dryness in the air above the plate.



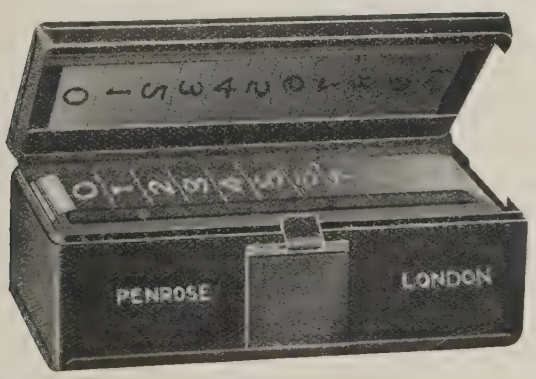
"Lithotex" Super Whirler.
Pictorial Machinery, Ltd.

A swing-over arm is fitted to effect the coating of the plate, while variable speed drive allows the very necessary control of the revolution of the plate.

In this machine any number of identical zinc plates can be coated and prepared, which is essential for uniform production. These whirlers are made in two sizes, for zinc plates $45 \times 38\frac{1}{2}$ in. and for plates $65 \times 48\frac{1}{2}$ in.

The whirling (and drying) of the zinc plates must be carried out under non-actinic light—either a red or orange shade.

When dry, the plate may be exposed under a negative in any good photo-process printing frame, preferably of the pneumatic type already referred to. The timing of the exposure may become a matter of personal judgment; but it is better to have a small printing frame as well as the working one, and expose a similar negative to photo-printing paper (P.O.P.), which, when showing deep enough for toning, will measure fairly accurately the exposure of the working frame. This expedient is only used when the craftsman has not an actinometer as sold by dealers.



ACTINOMETER.
A. W. PENROSE & CO., LTD.

A simple actinometer can be made by fastening eight or nine layers of tissue paper upon one another, each layer being say, $\frac{1}{2}$ inch shorter than the one before, thus obtaining nine equally successive shades. Each slip can be numbered, as it gives a more definite guide when in use. The whole pad can be put into a photo-printing frame, with a long strip of ordinary P.O.P. or silver photographic positive paper. In use it is exposed to the same light as the printing-down frame, and when the P.O.P. is of proper photographic strength, the negative in the printing-down frame can be marked with the number in this actinometer. In that way negatives can be all marked as a ready guide for further exposures.

LIGHTS FOR PHOTO-PROCESS WORK.

Messrs. Penrose & Co.'s Empire Arc Unit may be used for the printing-down frame, as well as for lighting the "copy" for making the camera negative. The arrangement of arc lamps, upon two rods, hung from two arms, gives every necessary adjustment for intense lighting on both small and large areas—as used in making printing plates or camera negatives—such as cannot be expected from two-point illumination (see pages 124 and 125).

Another illuminant they make is the "Sun Ray" Arc Lamp, specially suitable for three-colour work, but owing to a shortening of the blue and ultra-violet it is not so suitable for black and white work.

Their "Vioray" enclosed arcs are very powerful. They are in two patterns—one for copying and the other for printing.

The 15-amp. eight-carbon lamp suggested for the exposure has been tested against the enclosed arc, and has been shown to give greater effective light, thereby reducing the time of exposure. The carbons are automatically fed, with either variety of current employed. But when continuous or direct current is supplied, then resistances are required, and for alternating current it is necessary to have choking coils.

One of these lamps will be suitable for printing down an area of 30×24 in. For larger areas, two lamps should be used.

The exposed plate is ready for rolling up, and immediately after removal from the frame it must be rubbed with a rag all over solid with an ink made up of equal quantities of lithographic printing and transfer inks to obtain a fine grey film. The exposed parts of the film will take the ink; the plate should then be immersed in water just faintly warm, and rubbed gently with a pad of cotton wool to clear away the unexposed film. Give the plate a good rinse with water and remove any specks from the "whites" of the subject. Dry the plate and gum up evenly, and fan dry. Wash out the ink from the dried gummed surface with turpentine. Then pour on a small quantity of the strong ink or "doctor," spreading it over the plate where it will sink into the exposed parts of the film, and in due course should get through into the zinc plate. Allow it to stand to let the turpentine evaporate, then wash off the gum with water, using a clean cloth. This brings the plate into the same state as a transfer on zinc, and it is rolled up

with a good lithographic black printing ink; fan the plate dry, dust the work all over with talc and etch with a mixture of gallic acid one ounce, phosphoric acid half ounce, gum solution (creamy consistency) one and a half pints. This "etch" may be applied with a fine flat brush, or poured on and spread over with a clean sponge. The sponge must be well washed out before putting away. The etch known as Zetch is equally suitable and less trouble to make up.

After a few minutes the etch will have effected its purpose of securing a better union of the ink with the plate. Wash off the etch with water and dry the plate. Gum the plate all over and dry it. It is now ready for the ordinary procedure of printing, or taking transfers to make up the full-sized machine plate.

In giving the details of the direct method just described, it was mentioned that the recipes containing albumen given in Vandyke process are useful in the direct method, and three other recipes were given, each containing albumen.

Albumen alone has been found somewhat difficult to develop upon rough grained zinc, and experimenters have found that for such plates the following is a useful recipe. The film:—

Dry albumen	48 grains.
Lee Page's glue	36 ,,
Ammonium bichromate	15 ,,
Water	2 ounces.

This film is coated on the plate, dried and exposed as already described for the direct method. The variation occurs in rolling it up. Instead of rolling up solid as already set forth, omit that, and wash out with asphaltum solution (the strong washing out fluid previously described and called "doctor") or the made up article, Mogul varnish. Fan it dry and roll up with a deep nap roller in the ordinary lithographic manner. This treatment pulls off the unexposed film and, of course, any of the washing-out fluid adhering to it; but it does not touch the subject, which is covered or even penetrated through to the plate with the asphaltum.

The treatment after such wash out and rolling up is similar to that described in Chapter VII. The reason for making these references is to assist the reader in working these methods, by showing that at certain points in the various processes the manipulation comes back to a standard method of treatment.

Other than the methods already dealt with, in which albumen and fish glue are used with a bichromate, there is still another good film in which neither of these is used. The following recipes for sensitizing films utilize asphaltum as the light sensitive matter:—

	For Zinc.	For Aluminium.	For Stone.
Asphaltum	... 7 grammes.	7 grammes.	5.6 grammes
Yellow benzole	8 c.c.	9 c.c.	5 c.c.
Chloroform	...100 ,,	100 ,,	100 ,,
Alcohol...	... 36 ,,	35 ,,	28 ,,
Ether ...	... 50 ,,	50 ,,	50 ,,

Great care must be taken in drying by heat, in order that the film (that is, the grains of asphaltum) may be evenly distributed. If heated "by hand" against the source of heat, the lowest portion must be dried first, and the upper part fanned to endeavour to prevent the asphaltum all running down the plate. If in a whirler, the heat must be well distributed, and not more than a glow; whilst whirling must be moderately slow, to prevent the film being driven to the edges and the centre left bare. The yellow benzole in the recipe is a gas works' product.

In each case the subsequent treatment is the same as for direct work, described above, and in Chapters VII and X.

The possibilities of this asphaltum process are much greater than the albumen process, when it is carried out with great intelligence. It is, no doubt, the basis of what may justly be considered the finest method of quick and accurate production of colour work. In such a method the original painting is photographed without a screen, and from this negative are made several photo. copies on sensitized zinc. In the course of development the artist uses a solvent, with which he dissolves or wipes out such portions from each plate that are not required for the particular colour to be printed from that plate. The artist may, however, wipe out whole masses of shade which he will subsequently restore or replace by transferring to the plate some mechanical form of shading. For this purpose the well-known "Day's Medium" is particularly useful. As an alternative method the subject may be photographed through "three-colour" filters. From each colour negative may be photo-printed several plates of each colour, and such plates developed and treated with solvent and transfer shading, as when one negative

only is used. The three-colour method, however, dissects the colours to an extent and saves some of the artistic treatment. It is in this manner that works of four, five, six, etc. printings can be produced by the artist in one-quarter the time required for actual drawing, and at about one-third the cost. By this process have been produced many high-class prints; and when the work is printed by offset in seven to nine printings the result is so effective that it resembles a true water colour drawing. No other method has yet been equal to it, although the method in which collotype forms the base has been the source of many very fine productions.

THE "LITHOTEX" MACHINES.

These machines have been designed and constructed by Pictorial Machinery, Ltd., with the whole idea of eliminating the present tedious method of reproducing by transferring numerous small designs in the production of printing plates. By this means the multiplying up of the designs is done mechanically and photographically with great accuracy, eliminating the personal element. This is briefly the principle of the "Step-and-Repeat" machine, for example, in the production of stamps, labels of all kinds in one or multi-colour, it is obviously necessary to duplicate the artist's original design by some method to produce a large printing plate composed of numbers of these designs, and, of course, for colour work there must be accurate registration of colours.

The machines described, that is the "Lithotex Step-and-Repeat" machine, and the "Printex Junior" Mechanical Negative Printer, are both machines of this nature, differing really only in the final form in which the designs are produced. The "Lithotex Step-and-Repeat" machine produces from a single unit a negative or positive on film, glass or paper, while the "Printex Junior" Mechanical Negative Printer produces from a unit negative the finished printing surface on zinc, aluminium or stone.

"LITHOTEX" STANDARD "STEP-AND-REPEAT" MACHINE.

This machine is a "multi-negative producing machine," and it takes the form of a projection apparatus of a special type, with various movements fitted, so that the image which is projected can be accurately repeated on to the sensitized film plate or paper as required.

In this machine a transparent unit negative or positive is placed in a holder before the light of a powerful battery of mercury vapour tubes. The unit is then projected through a suitable lens to the multi-negative, which is held vertically by special mechanism, allowing it to be moved in two directions, vertically and horizontally. Other controls on this machine enable the projected image to be rotated, enlarged to two and five-eighths, or reduced to five-eighths, during which change of size the image is *automatically in focus all the time.*

The front part of this machine is enclosed in a dark room in which the operator is working, while the lantern and unit are outside. Once the image is of the correct size, and corrected if necessary as to squareness, the negative is inserted in its special holder and the process of building it up into a multi-negative is then started, having made the necessary calculations previously for the number of exposures and distances.

By means of the special electric time clock a number of identical exposures are made across the negative, the movement of this being controlled by screws, dials and indicators, accurately adjusted to one-thousandth of an inch.

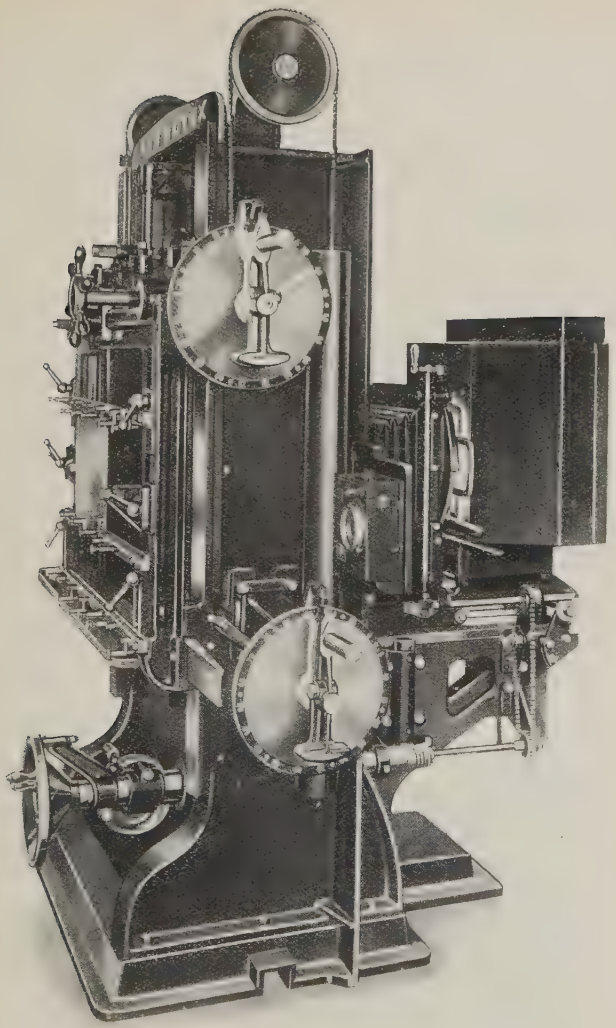
In this manner from a single unit, a multi-negative, or a number of multi-negatives, are all correctly exposed and are identical as to distances between subjects.

The dimensions of the "Lithotex" machine are as follows: Height, 7 ft. 6 in.; width, 7 ft. 3 in.; weight, 30 cwts.

The machine is easily operated, has been constructed fool-proof, incorporates world patents and is used in very many printing houses throughout the world.

The work in which this machine is most suitable is in repetition printing, such as labels of all kinds in multi-colour designs, cartons and containers, such as cigarette and match boxes; security printing, bank notes, stamps and cheque tints, textile and wall-paper printing, giving continuous designs from a single design, tin printing in any form, playing cards, post cards; process blocks, giving a number of identical originals to be etched at same time; magazine covers, calendars, etc.

The maximum negative that this machine will produce is 35×25 in. from a unit up to 12×10 in.



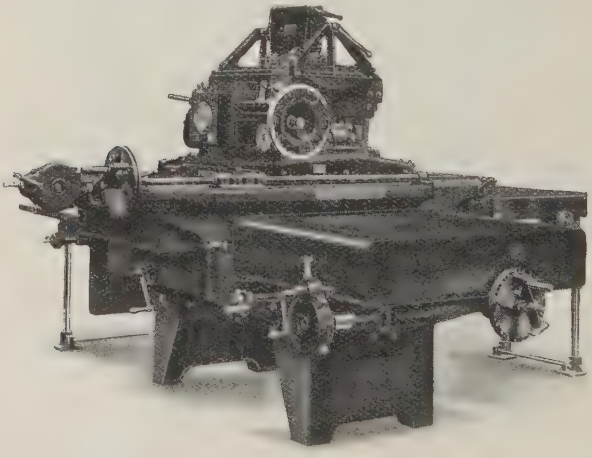
"Lithotex" Standard Step-and-Repeat Machine.
Pictorial Machinery, Ltd.

To meet the demand of a cheaper and less elaborate machine for less elaborate work, the Simplified "Step-and-Repeat" machine has been produced. In this model there is no automatic focus, this being arranged by setting the focus and reading on the indicators, while the largest negative possible is 31 × 25 in.

"PRINTEX" MECHANICAL NEGATIVE PRINTER.

This machine, as previously explained, is a "Step-and-Repeat" machine, except that its stepping-up of the unit negative is by contact instead of projection on to the actual printing surface of metal or stone, instead of on to a photographic plate or film.

The unit is loaded up into its holder and placed under the light from a powerful arc lamp. The zinc plate or stone is loaded up on to its bed and moved into its correct position underneath the negative. By suitable gears, dials, indicators, etc., the negative is moved in one direction at right angles to the bed, allowing this unit to be moved and covered over the entire surface of the zinc plate.



"PRINTEX JUNIOR" DIRECT MECHANICAL NEGATIVE PRINTER.
PICTORIAL MACHINERY, LTD.

"Lithotex" Step-and-Repeat Multi-Negative Work. Line and Tone Work, Reduced or Enlarged.
Pictorial Machinery, Ltd.

The exposures are all controlled as on the "Lithotex" machine by the patent "Lithotex" time clock, while the contact, an important feature on this machine, has been very specially designed and catered for by safety devices, which are patented.

One of the special features of this machine is that during the exposure of any one image, the unit negative is accurately moved into position for the subsequent exposure. In this way this machine produces in the quickest manner possible the completed plate. Other features are that the screws are specially designed to eliminate inaccuracy of back-lash.

The machine is entirely fitted with safety devices and accurate register controls, so that a number of zinc plates can be consecutively produced as regard register and quality. The largest unit accommodated is 20 × 16 in., and the surface that it can print on is 53 × 37½ in., larger sizes being accommodated by spacers if required.

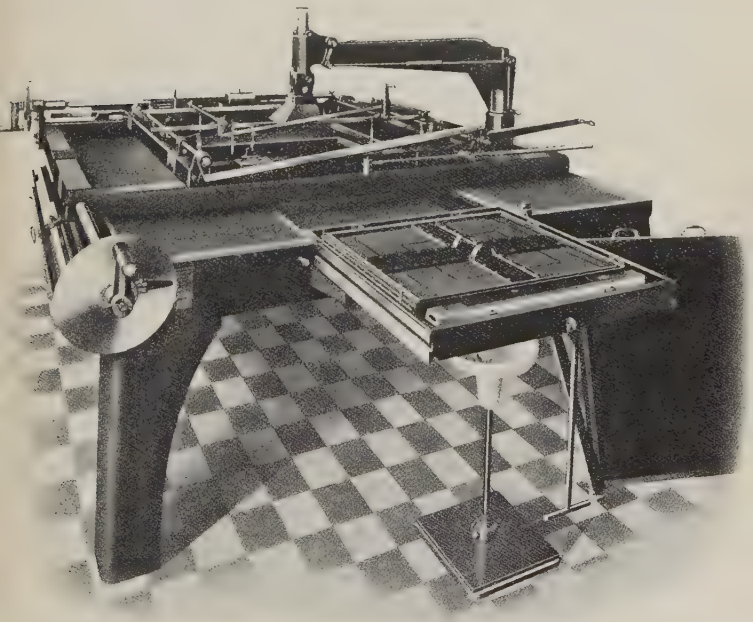
The dimensions of the machine are as follows:—Width, 10 ft. 8 in.; height, 6 ft. 6 in.; weight, 2 tons 18 cwts.

THE "OGDEN" MULTIPLE DUPLICATING MACHINE.

This photographic copying invention is the appliance for repeating few or many copies of a design upon a printing plate for either direct or offset printing. The special features of its utility are that the machine is horizontal, and the negative and printing plate by their own dead weight tend to preserve absolute contact. The horizontal position makes the manipulation comparatively easy, and the more delicate operation of adjustment can be effected in full clear light. The latter point is very important, as every movement of the plate can be regulated to one-thousandth of an inch in each direction, such movement being read off on Vernier scales, as well as upon discs fixed on the ends of the worms which make the movements.

In this machine any line or dot negative can be used regardless of its thickness of glass: it need not be on rectangular glass, nor is it necessary to have its edges ground or bevelled. The negative glass is easily and securely mounted and when it is placed in the machine it is secured so that it is not moved during the subsequent operations. One of the principles employed and patented is that the sensitized plate is turned over on the negative: in this position the plate only

is moved from one position to another, and the actual exposure is to a light below the machine. The light being hidden, it does not glare at the operator; this coupled with the fact that all adjustments of the plate can be carried out in full light



THE "OGDEN" MULTIPLE DUPLICATING MACHINE.
AMERICAN MACHINE & FOUNDRY COMPANY, LIMITED.

above the machine, marks this method as one of the most comfortable proceedings of recent times. By means of this machine it is comparatively easy to produce multiple negatives, so that many copies may be photo-printed on plates in a minimum of time.

The machine is made in four sizes, viz.:—No. 1 for negatives up to 17 × 14 in. and printing plates up to 37 × 32 in.; No. 2,

for negatives up to 20 × 16 in. and printing plates up to 50 × 40 in.; No. 3, for negatives up to 22 × 18 in. and printing plates up to 55 × 45 in.; No. 4, for negatives up to 24 × 20 in. and printing plates up to 65 × 48½ in. The sizes 1, 2 and 3 are worked by hand throughout, whereas the No. 4 is electrically driven in all the machine adjustments.

More than eighty machines have already been installed in houses doing tone-block colour work, lithography, metal plate decoration, speciality work, and letterpress printing—where offset is being employed. It may be noted that machines have been purchased by two Government departments. Satisfactory reports from these houses as to the durability of the plates produced, the speed of execution and the general economy, go far to show the appreciation of this recent addition to the appliances available by printers.

The method of operating this multi-duplicator is largely a matter of common sense. In the first place the negative has to be marked on its margins with centre lines both ways, giving the exact centre lines (each way) of the work to be produced. The marked negative is placed film side up upon a glass plate, which is fixed rigidly in a frame which slides in grooves to the centre of the main machine. On the edge of this frame is hinged (temporarily) a register tympan carrying two cross strips of celluloid, upon which there are engraved very fine lines showing the exact centre (both ways) of the frame. This register tympan is brought down on the negative, and the negative is then adjusted until the centring lines of the tympan and negative absolutely coincide. The negative is fastened down, and a paper mask is cut to eliminate the edges outside the actual work. The mask is made to adhere, the hinged tympan is removed and the whole frame, bedplate and negative are slid into the main machine, where it is locked securely for the final exposure.

The printing plate is sensitized and whirled, and dried by a complete double row of small gas jets across the diameter of the whirler, and placed under the plate. The plate is mounted on a rubber covered frame in a suitable position with its long edge parallel to the edge of the frame. It is fastened down and is ready in a few moments to be turned completely over and slid into the side tracks of the main machine, face downwards, on the negative. This frame fits dead true into the side and end tracks of the carriage of the machine. The

position of the plate for the first print from the negative is obtained by turning the worms at one side and at one end of the carriage, and determining the position by the Vernier scales on the two sides of the machine. When the position is exact, the Vernier scale readings are taken. The absolute contact of the plate with the negative is obtained by direct pressure of about 200 lbs. per square inch, exerted through levers in the arm over the machine, and imparted to a wooden platen. The platen used should be slightly smaller than the negative glass. After the pressure has been applied, an air current is blown across the negative to keep it cool during exposure. The arc light is turned on and the exposure is timed. The time may be from two to six minutes —aluminium taking less time than zinc. At the end of the first exposure the light is turned off, the pressure released, and the carriage is moved by the worms and gauged by the scale for the second printing. Then the previous operations are repeated, and so on until all the exposures have been made.

The plate is removed, rolled up solid, developed under water with a pad of cotton wool, dried, gummed up, and is ready for the wash-out and etch, and then for printing in the machine. Such a plate with two exposures occupies short of thirty minutes in preparation for the machine from start to finish.

In this machine the air-blast and the arc light are placed under the centre of the machine in a fixed position directly centred with the negative (which is also fixed) and, therefore, the illumination is always the same, and produces plates of even exposure.

It needs but the exercise of a little thought to see that if a single small negative be used, and a large sensitized photo-plate be mounted on the plate frame, that by the same series of operations a new positive photo-plate can be made with a large number of copies on it. From this positive a negative can be produced, and used for making up a printing plate with 100 to 200 or more on it. For the making of these multiple positives and negatives the arc-lamp is replaced by an incandescent half-watt lamp, and each exposure is reduced to one second, or less.

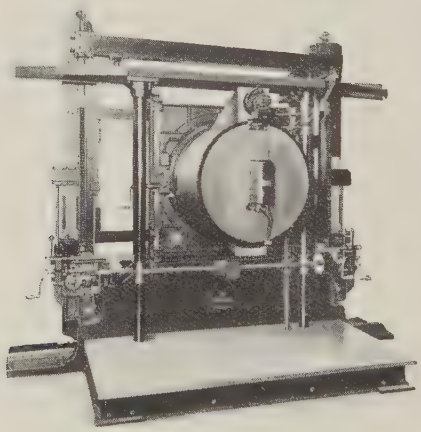
In a similar manner any good impression taken from stone, or copperplate, or type, can be reproduced as a negative by exposure in contact with a sensitive plate, by transmitted

light. Such an operation, however, is limited to the production of work the same size as the original.

This machine is in the hands of the American Machine and Foundry Co., Holborn Viaduct, London.

HUEBNER-BLEISTEIN METHOD.

This method is the outcome of the patents granted to William C. Huebner from 1906 onwards, and may be taken as the basic principles as well as the mechanical details of all other methods since introduced. The original machine was in a very highly-developed condition in 1911, and has since been improved in every particular, until it is now a machine



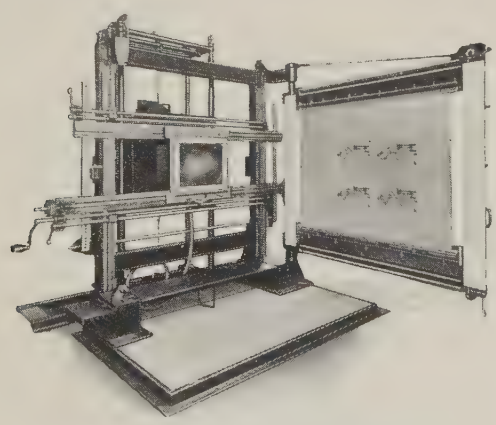
"PRECISION" PHOTO-COMPOSER.
HUEBNER-BLEISTEIN PATENTS COMPANY.

of the greatest precision. In fact the Huebner-Bleistein Patents Co., of Buffalo, U.S.A., have also made a new machine on the lines of the "Lithotex."

The American Company has adopted the term "The Art of Photo-Composing" for their machines. This term is liable to confusion of ideas. It is always understood, at least, in Great Britain and the Colonies, that the craft of composing is the putting together of individual stamps or

types (of letters especially) for reading matter; and is further used to differentiate between hand composing and machine composing. Further, the only photographic machine for photo-composing, in this sense, is the one made by the August-Hunter Development Syndicate, of Walworth, London, which is described in this chapter.

The Huebner-Bleistein Precision Photo-Composer. This form of machine was the original model, and unlike the Lithotex in that the negative is held rigidly in its frame, and the sensitized printing plate of zinc or aluminium is carried to and fro, and up and down, to receive the photo images. The plate is moved accurately by the finest worms,



"Utility" Photo-Composer.
Huebner-Bleistein Patents Company.

having fine scale indicators or discs, and thus can be used for exact register work. It may be considered that this form of machine has in some respects some advantages. For instance, a sensitized plate of 51 × 67 in. may receive photo images all over by successive images, instead of using multiple negatives and printing them down successively on a sensitized printing plate. The printing plate being produced at one operation, which upon development and rolling

up is ready for the printing machine. Against this it must not be overlooked that each exposure on the printing plate takes very many more seconds than in the method of making multiple negatives. Another feature of this machine is that large subjects can be projected upon the printing plate.

In the present model of the machine the negative holder is mounted in a cylinder which can be turned at any angle to project the subject on the printing plate.

Negatives of all sizes, from 8×6 in. up to 32×28 in. can be used, and by the proper adjustments the subject may be reduced or enlarged. The exposure is controlled automatically.

The dimensions of the machine are:—Length, 18 ft.; width, 10 ft.; and height, 10 ft. The printing plate may be up to 67×51 in., for register work up to 64×44 in.

THE "UTILITY" PHOTO-COMPOSER.

In this machine the movements are the reverse of the "Precision," in that the sensitized printing plate is held

"H-B" Commercial Photo-Composer.
Huebner-Bleistein Patents Company.

rigidly, while the negative carrier is made to travel transversely or vertically, to cover the whole plate with images. The mechanism, indicating scales and automatic exposure

controls are all made with the same fine workmanship as the "Precision," to secure exact register.

Negatives of all sizes from 8 · 6 in. to 58 × 42 in. may be used for register work up to 64 · 44 in. The size of the machine is the same as the "Precision" machine.

"H.B." COMMERCIAL PHOTO-COMPOSER.

This is a printing-down frame in which the negative can be moved in both directions by very fine worms with scales and indicators. The sensitized plate is fixed rigidly on a table, and its surface is covered with shutter-blinds, which can be set for each successive exposure. The light is from a lamp overhead, and can be adjusted to suitable positions. The negative is brought into direct contact and rigidly held, for each exposure. There is no plate glass frame to raise at each exposure: the negative and the shutter-blinds only have to be adjusted.

It is made to take plates up to 52 × 38 in., and any size of negative on glass, celluloid film or paper can be used. The negative need not be bevelled, nor absolutely rectangular.

It is a compact table machine, about 5 × 4 ft. and 3 ft. high.

THE "H.L." STEP-AND-REPEAT PROJECTOR.

The "H.L." Step-and-Repeat Projector is a machine for the production of large negatives consisting of any number of small duplicated images, these large negatives (or positives) being utilized for the production of the printing surface for lithographic, offset, photogravure or typographic printing. They are also used for the production of printing cylinders for rotary gravure, textile and wall-paper printing, etc.

The spacing of these small images is controlled with absolute mechanical accuracy to adjustments of one-thousandth of an inch, or in the case of machines with metric adjustment, to one-fortieth of a millimetre.

If the subject consists of more than one colour, the precision of the machine is such that multiple negatives can be made for each colour and the whole will be in absolute register.

The machine is built for rigidity and accuracy under all conditions, and incorporates many original improvements which make the working operations extremely simple. It is

designed to cover a wide range of work, due principally to the following factors:—The frame will accommodate plates for the multiple negatives up to 40 × 30 in.; a unit up to 12 × 10 in. can be projected accurately and evenly, and enlargements and reductions of three diameters can be obtained.

Consequently, multiple negatives, consisting of perhaps a thousand of the smallest labels, or a few repeats of a large subject such as magazine covers or showcards, can be made with equal ease. Stamps, labels of every description in line or tone and in any number of colours, letter-headings, cigarette stiffeners and cartons, packing labels, cheques, currency notes, etc., all are within the scope of the "H.L." Step-and-Repeat Projector.

The first requirement is a straightforward negative, preferable wet collodion, from which is made a glass positive, either by contact or in the Step-and-Repeat machine. Should the subject be a small one requiring a large number of repeats on the final negative, it is advisable to make a multiple positive consisting of say twenty or thirty images, so reducing the number of repeat operations when making the final negative. The positive is placed in the projector and the projected image is focussed to size, and alignment corrected. (It is possible to rotate the unit throughout the full 360 degrees).

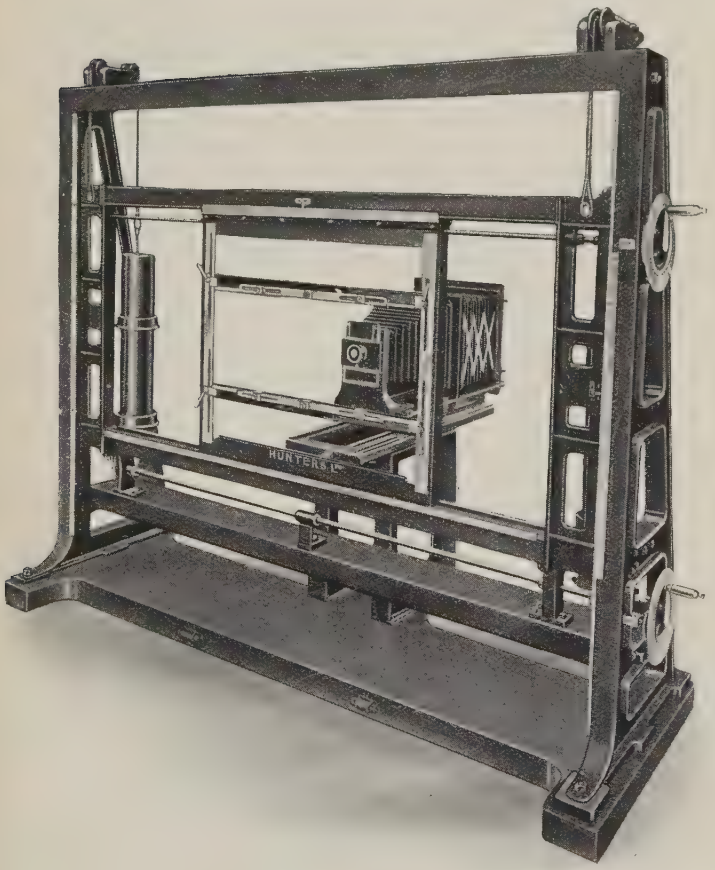
Dry plates, films and—for certain classes of work—negative paper can be used, and naturally result in a very considerable saving of time.

It should also be taken into consideration that with very long runs, this multiple negative can be used for making an almost indefinite number of machine plates.

THE H.L. "REPETEX" DUPLICATING MACHINE.

The latest machine made by Hunters Ltd. is the H.L. "Repetex," by which a negative may be multiplied by the step-and-repeat method direct on the machine plate, instead of making a multiple negative.

Briefly, this machine consists of a large rigid iron bed, firmly supported. A smooth rubber blanket is stretched taut over the surface of the bed and on this the machine plate is secured during manipulation. At each side of the bed is an accurately machined bearing surface and guide, along which travels a strong bridge. This also has a bearing surface and



The "H.L." Step-and-Repeat Machine.
Hunters Ltd.

guide at each side which accommodates a movable centre structure consisting of the light box, the measuring scale for the negative holder, the arc lamp, and the pressure gearing.

The movement of the bridge is effected by a massive square threaded screw, controlled by a hand wheel with a finely calibrated dial. The lateral movement of the centre structure is similarly controlled. A motor is provided to operate the bridge movement when desired.

The negative to be printed is secured accurately in the required position on the negative holder. The whole is then clamped in position under the centre structure. After each exposure the centre structure is moved in the required direction, the degree of movement being definitely controllable to one-thousandth of an inch. The negative holder can be placed in any one of four positions, that is, it can be rotated 90° in either direction or completely reversed, *thus eliminating the necessity for re-registering the negative on the holder.* Further, no matter in which position the negative is placed, its centre will always remain constant, so removing any difficulty in ascertaining the position of the negative relative to the plate.

The whole design of the machine is such that its operation is extremely simple and quick, at the same time results are assured which are absolutely and mechanically accurate.

The time taken for attaching the prepared plate and commencing the first exposure need only be about 10 seconds; the time for each repeat including re-adjustments and an exposure of $2\frac{1}{2}$ minutes is about $2\frac{3}{4}$ minutes. If the negative has to be rotated 90° or 180° this would take approximately 2 minutes. After the final exposure the plate has only to be lifted off the bed of the machine on to the inking-up table.

The machine accommodates any size of plate with a printing area up to 60×40 in., and will take a negative up to 20×20 in., the over-all floor space is 7 ft. 4 in. $\times$ 9 ft. 2 in. Multi-negatives can also be prepared on the "Repetex."

As it rarely happens that negative glass is of equal thickness throughout, a cushioning device has been incorporated in the pressure transmission which automatically compensates such inequalities.

A brief description of the method of operation is as follows: The negative with a register line in the centre of each end

and one side is placed approximately in the centre of the glass of the negative holder and secured there by means of suction. The registering cross is placed in position, and by means of fine screw adjustments two register points are adjusted with absolute accuracy in line with the end register marks and equi-distant from the centre of the negative. The cross is removed and the negative masked with tinfoil if necessary. The holder is placed face down on the bed of the machine and the centre structure brought to the determined position which is immediately over the holder.

The light box is lowered and the two register points, mentioned above, centre themselves in corresponding points on the frame which are in absolute alignment with the travel of the machine. The negative holder is then secured by means of four clamps. A prepared machine plate is placed in position on the bed of the machine, the marked centre of the gripper edge being placed immediately over a centre mark on the edge of the machine bed.

The remainder of the operation is self-evident from the above details of the structure of the machine. By drafting an accurate lay-out, all positions for the negative can be obtained by the movements of the bridge; and any coloured design can be equally well dealt with, for all the colour plates.

THE "H.L." PATENT REGISTER MODEL PRINTING-DOWN FRAME

is in general form similar to the All-metal Frame described above (page 123), but the positions of the glass and plate holding frame are reversed, the machine plate being "face down." The operation of this machine can be compared to the lithographer's method of laying out a large sheet of repeats. In that method a perfect lay-out is made for the key, with all the first transfers on it, complete with register points. After that has been transferred, impressions (known as "keys") are pulled for patching up the succeeding colours by the shining-up method. Now reverting to the above printing-down frame, the first act is to prepare a lay-out showing the positions of the register marks and the two lines representing the cross centres of the machine plate.

The positions of these register marks relative to the two cross centres of the machine plate are ascertained and equivalent points can be indicated on the frame by means of a

special device enabling cursors, i.e., small sighting register marks engraved on celluloid, to be temporarily positioned with absolute accuracy. The negative is placed on the supporting glass of the frame with the register marks directly under those of the two cursors. Accurate positioning of the negative is facilitated by the use of tubular eye pieces. The negative is then secured to the frame glass and surrounded with strawboard, approximately the same thickness as the negative glass, to prevent indentation of the machine plate. The coated plate is firmly secured in the centre of the upper frame by means of clamping bars adjustable to any size of plate. The whole is then lowered, contact secured in the usual manner and the frame rotated to printing position. Masking blinds protect all parts of the plate not being exposed to the negative.

After exposure the frame is opened and the negative placed in its second position by the same accurate registering device. The exposure through the blind-mask is made; and thus by repetition of these accurate adjustments the whole plate can be covered with the same subject. It is obvious that if other subjects are required they can be added in the same way, and two or three negatives used and printed down at one exposure.

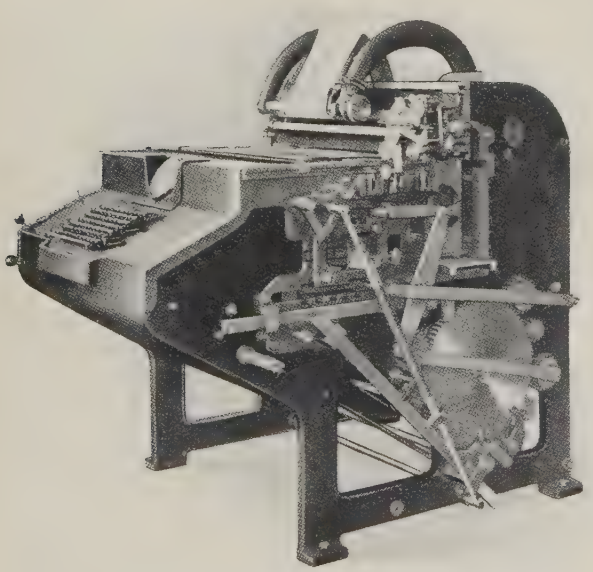
Of the half-tone methods, or photo-tone methods, applicable to metals, perhaps no process has proved so successful in manipulation or in printing as Frey's Process. It is very difficult to tell why large firms have not availed themselves of this screenless process to a much larger extent. The process was not patented, and to some extent its operations are secret. The zinc plates are sensitized with a film, soluble in benzol, so that when a photo-print is put on them, parts of it may be skilfully wiped off with a pad of cotton wool and the solvent, and in this manner colour stones are readily prepared. Additional work can be made to the plates by medium, crayon or brush; so that the process largely depends upon artistic skill.

The use of a Wheeler Metzograph Screen or the Acme tint method (illustrated in *The British Printer*, Vol. XXII, No. 128, April-May, 1909) of producing the negatives, has a tendency to make work more suitable for planographic printing. In using this method it is advisable to make positives from the three colours. The negatives should err rather on the soft than on the hard side, and, in making them,

use a small stop and long exposure, with the screen almost in contact with the plate. In exposing the plate under the negative choose a soft light and give a long exposure.

THE "TYPARY AND TYPON" PROCESS.

In the preceding pages references have been made to the "Typary and Typon" methods of obtaining photo-litho. copies of originals, whether as set type, printed illustrations



THE TYPARY TEXT TYPING MACHINE.
TYPARY & TYPON CO., LTD.

or original drawings, as exhibited and demonstrated at the Printing Trades' Exhibition, 1925. This method, whether used in part or as a whole, must have appealed to printers as very ingenious and certainly embodied some useful novelties. In fact the photo-copying was executed in a manner which

struck a new note in process work, adaptable to producing originals for offset printing.

The method is distinctly in two parts—quite separate and not dependent upon one another. The "Typary" section is devoted to composing text matter and incidentally taking an impression. That is, it produces the equivalent of a first proof, properly set, spaced and justified, all of which operations are entirely automatic. An expert operator may manipulate 12,000 to 15,000 ens per hour as well as having at the same time a complete proof in good ink on the special paper, ready to pass to the photo-copying department.

It may be said that anyone who has just ordinary intelligence can manipulate the machine and attain a fair speed. It is worked from a keyboard with 84 keys and a shift lever, so that, in all, 225 characters can be brought into use, including the necessary spaces. The whole keyboard is of the universal type, as on most typewriting machines.

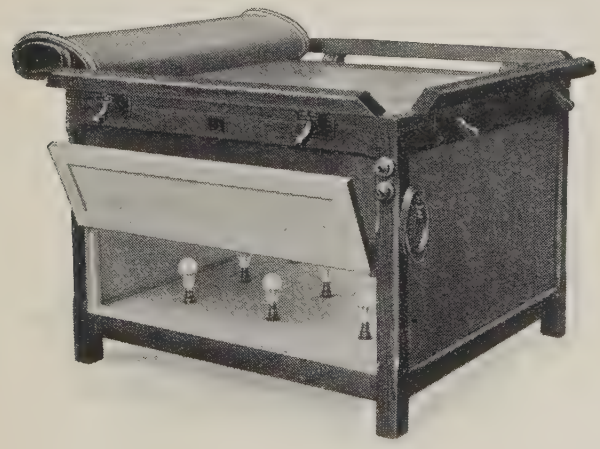
The machine as at present made holds one complete magazine of one body of type, the fount being upper and lower roman, upper and lower italic, and small caps. The change from roman to italic or small caps. is effected by the shift lever on the keyboard. The sizes of type, from 6-pt. to 14-pt., are each contained in separate magazines, which can be readily placed in the machine and the necessary adjustments made to suit body size. This makes the machine a complete equipment for newspaper, book and magazine setting.

To emphasize the commercial value of the machine it may be stated that in "setting up" a book no type metal is necessary. The whole work is produced as proof slips on paper, which are then photo-printed to produce negatives from which, when mounted for imposition, positives can be photo-printed upon metal for offset printing. As these negatives can be photo-printed from each side, the printing plate may be produced to suit offset or direct rotary printing. After the negatives have been used they can be stored for future use, in case of a reprint.

It is also possible by using a translucent paper in the machine, to produce proof slips which can be photo-printed on the metal plate by a positive process, thus eliminating the production of a negative.

Further, such paper may be photo-printed down from either side, providing that the printed matter be bronzed to increase the opacity.

The "Typon" section is devoted to the photo-production and can be utilized for anything and everything for which negatives are required for printing photographically the positives on printing plates for either offset or direct printing. Much of the work can be done without a camera, so long as the reproduction has to be the same size as the original. Further, when the camera is brought into use, the Typon strip-film paper is used instead of either photographic wet or dry plates.

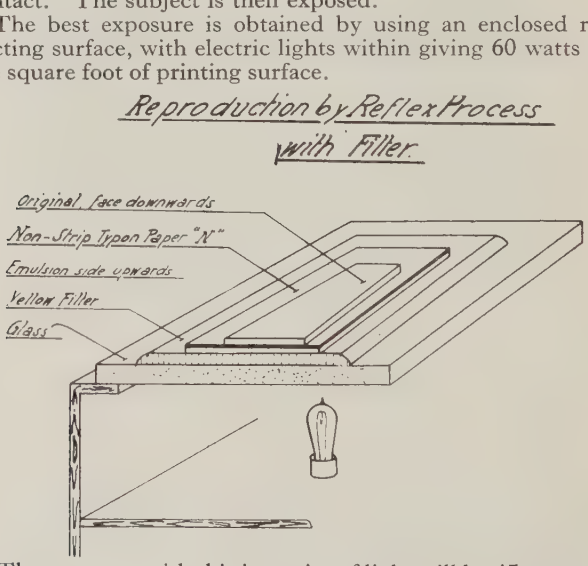


TYPON VACUUM CONTACT PRINTING FRAME.
TYPARY & TYPON CO., LTD.

The only plant actually required for making negatives the same size as the original is a good printing frame, vacuum for preference, and of a size to suit the class of work being done; a large printing frame for producing the printing plate by exposure to arc-lamps, and supplies of the Typon photo-papers and films, with a large yellow filter of glass or celluloid, and several large dishes for developing and fixing the photographs produced. Such a plant as used for photo-lithography, with the addition of the filter, is all that is necessary.

To illustrate the use of these Typon papers a few examples may be given, such as arise in the ordinary course of the printing business. At the outset, when the original is, say, a black impression, it is necessary to produce a negative first before it can be "printed" down upon the sensitized printing plate. Take a line drawing—an engineer's or architect's drawing on Whatman paper, a line print, a press proof of type matter, a sheet of music, or the like, executed on paper with matter also on the other side, and follow this procedure:—Place on the glass of the printing frame the yellow filter, then a sheet of the Typon "N" non-strip paper, face up; upon this place the copy, face down; cover with a black cloth, and close the frame and pump out the air to bring the items into perfect contact. The subject is then exposed.

The best exposure is obtained by using an enclosed reflecting surface, with electric lights within giving 60 watts to the square foot of printing surface.



The exposure with this intensity of light will be 45 seconds. The development can be carried out in a yellow-lighted room—either with a yellow blind to exclude the source of light, or with yellow tinted globes over the entire source of light in a room without windows.

As these Typon papers are of a new type they require development and subsequent treatment by solutions of a nature which suits them and gives the most perfect results. The craftsman who handles them must therefore adhere to the formulæ and practice recommended.

The development is effected in the following bath:—

DEVELOPER FOR ALL THE PAPERS AND CELLULOID FILMS.

Distilled water	1,000 c.c.
Hydrokinone	30 grammes.
Metol	3 ,,
Sodium sulphite (re-crystallized)	225 ,,
Potassium carbonate (dried) ...	225 ,,
,, bromide	30 ,,
,, ferrocyanide ...	45 ,,

For use, use one part of this solution with two parts of water. To make the solution, use the water (1,000 c.c.) hot and add each ingredient one by one, until it is dissolved; then add the next, and so on. If when complete some crystals appear, then the whole must be warmed up, and stirred until all have disappeared. The solution must be cool before use.

After development the photo-print is fixed in a solution of:

FIXING SOLUTION FOR NON-STRIP PAPER.

Distilled water	1,000 c.c.
Hyposulphite of soda	600 grammes.
Sodium bisulphite	45 ,,

Use one part of this solution to three parts of water. The "fixed" negative may have a fogged appearance, but that is of no moment. After it is washed and dried, proceed to make a positive from it by direct contact with the sheet of the same Typon "N" non-strip paper. The negative is placed face up on the glass of the printing frame, the new unused "N" paper is placed face down upon it, the back is covered with a black cloth, the frame closed, and the exposure of 10-15 seconds is given. The photo-print (now a positive) is developed in the same solution as the previous (negative) print, except that the amount of water added is six parts to one part of the solution. After development, fix in the above fixing solution, wash and dry. It is now a positive print on one side of the paper only.

Such a print is similar to any other matter which has to be converted into a negative from which the final positive prints are made upon the actual printing plates or cylinders of printing machines.

This positive is placed face up on the glass of the printing frame, and upon it is placed a sheet of the Typon "D" anti-halation paper (or similar celluloid film); these anti-halation papers and films have a colour coating underlying the emulsion, which prevents halation. The exposure may be three to five seconds, and the development is to be in one part developing solution to three parts water. After development, rinse well under a good flow of water, and immerse in a solution of three per cent. acetic acid. Remove it after two or three seconds and again rinse it well. The print is then immersed for seven minutes in the alum fixing solution:—

FIXING SOLUTION FOR ALL THE STRIPPING PAPERS AND CELLULOID FILMS.

Distilled water	1,000 c.c.
Hyposulphite of soda	300 grammes.
Potassium metabisulphite ...	30 ,,
Alum (powdered)	50 ,,

The alum may be omitted for celluloid films.

After fixing, rinse well and dry it. It is then ready to strip so that it may be used for printing upon a sensitized zinc or aluminium plate for offset printing.

To strip the negative, first trim the edges to about a quarter-inch to get rid of possible damp edges. This cutting also gives a straight edge to facilitate the insertion of a dull knife all round under the stripping film. When the film is carefully raised it may be finally pulled from the support. This film can be kept after use, as an original for any future issue.

By making a number of these stripped negatives by successive exposures, a large number of positives can be photo-printed on one plate for a large issue of the same subject. Or, a series of pages can be converted into stripped negatives and all photo-printed upon a plate to make a section of a book or even a whole "book" of, say, music. The application of this method of reproduction can be varied indefinitely by any thoughtful craftsman.

From what has been stated above it is clear that in the last stage of the photo-work, the last positive print is in all

respects similar to any new proof from type or block or drawing, which is on paper without anything on the other side. The treatment for producing the final stripped negative for such original work is therefore exactly the same, and need not be repeated.

MAKING UP A PRINTING PLATE.

The making up or imposing for a machine plate requires much the same care and exactitude as exercised by lithographers. Before making the final strip negative the copy should be marked for register by drawing register marks, just outside the work, on all four sides, at the exact centres of the work—vertically and horizontally. The mounting sheet should be ruled out for the pages, and each page should have central lines across it—vertically and horizontally—to which the strip negatives can be registered.

If it be a subject in several colours, then the positive prints of the colours must be similarly marked so that the film negatives can be registered on the same key. But before mounting negatives place a sheet of clear paper, or varnished transparent paper, all over the face of the mounting key and attach it at the corners with photo-mounting paste—do not use a thin, watery paste. The negatives can then be mounted (patched up) on the clear sheet and fastened at two diagonally opposite corners only. All clear transparent spaces between the negatives must be covered with black paper, using as little paste as possible. The outside margins should also be covered with black paper. This practice is similar to other processes and is well known to photo-process workers. If celluloid film negatives be used along with paper negatives, the spaces round the film should be covered with tinfoil, cut accurately to prevent overlapping the paper negatives, so as to obtain even contact when printing down on the plate.

Should the whole plate be made up from celluloid film negatives, such films should be mounted on a sheet of plate glass. The register points for patching up can be drawn on the plate glass with Indian ink. The films must be cut so as not to overlap, and all clear spaces between films must be covered with tinfoil.

CAMERA WORK.

The Typon paper manufacturers have produced a special paper ("K") for use in the camera, as a substitute for both

"wet" and "dry" plates. It is a stripping paper with all the attributes of a good photographic sensitive plate, as well as the advantage that the preparation of wet plates may be avoided.

In addition to this "K" (camera) paper, there has quite recently been introduced a film for use in the camera known as "F-K" film. It is a celluloid film made expressly for camera work in continuous tone, half-tone, and fine line. It is three times faster than the contact film and is very thin, being only one-tenth of a millimetre thick.

This Typon "K" paper is absolutely devoid of halation, a property which has been obtained by introducing a colour layer under the emulsion. This colour layer partly disappears in development, and is finally dissolved out after development by immersion in a bath of acetic acid (glacial) three parts and water one hundred parts.

The exposure with ordinary two-carbon light (5,000 c.p.) is about thirty seconds at F32.

It has been proved to give excellent "half-tone" negatives with screens of 120, 135, 150 and 175.

Although there are appliances for holding this paper for exposure in the camera, it can, however, be easily done by placing it between two sheets of glass, in the dark slide. The front glass must be perfectly flat, of even thickness and free from any trace of colour, especially yellow. The thickness of the front glass must be recorded, so that before the exposure the camera extension can be racked to allow for the thickness of the glass and bring the sensitive paper into the focal plane.

After the exposure the paper is developed in the same developer as already given, with the variation that for very fine line work and "half-tone" use one part of the solution to four to six parts of water. From the development bath the paper is well rinsed with water, and placed in the bath of three per cent. acetic acid for a few seconds. Then rinse well with water and immerse in the alum fixing solution, already given above, for seven minutes. The paper is then thoroughly washed in the usual way that is common to photography. When dry, the emulsion film can be stripped in the manner already described and is ready for use for photo-printing on printing plates.

A further note upon this photographic manipulation is necessary, as there may be occasions when the "copy" on the

board may be badly lighted and would require a longer exposure. In that case use the special developing solution:—

SPECIAL DEVELOPER.

Distilled water	1,000 c.c.
Hydrokinone	12 grammes.
Metol	8 ,,
Sodium sulphite	120 ,,
Potassium carbonate	80 ,,

with, say, ten to fifteen grammes potassium bromide. The solution is made with hot water in the manner already described and allowed to cool.

INTENSIFICATION.

When necessary, the negative may be intensified, before stripping, by immersion in:—

Distilled water	1,000 c.c.
Mercury bichloride	30 grammes.
Hydrochloric acid, 10% ...	5 to 10 ,,

and afterwards to blacken it, immerse in:—

Ammonia liquor, 5%

REDUCTION.

To reduce the density of the Typon negative it can be done before stripping by careful treatment with a solution of:—

Hyposulphite of soda, 20% ...	100 c.c.
Potassium ferricyanide, 10% ...	2 to 10 ,,

The ferricyanide must be used as weak as possible, only using the maximum quantity in extreme cases.

In use lay the negative on a flat, clean surface, and for "local" reduction use the solution on a small wad of cotton wool and immediately wash off with water. If the whole negative must be reduced, place it in a very weak bath of the solution for a few seconds, then wash with water. This may be repeated until the reduction is satisfactory.

After intensification or reduction, the negative must be well washed, and dried, before being stripped.

THE CELLULOID FILM—TYPON "F."

This film is made to replace negatives on glass, and has the characteristics of the best sensitive plates in the market. The celluloid base is highly transparent, and the film has usually a speed for exposure as fast as, or even faster than the

"wet" plate. It may be used in the camera, as well as for taking contact prints in the photo-printing frame. For the latter it is of great value, because of the sharpness and clearness with which any screened subject or continuous tone subject can be produced. In making up the colour plates of a subject from black impressions, it is exceptionally useful; and for close register work its rigidity gives it considerable advantages.

The treatment after exposure is the same as the Typon anti-halation products. It is developed in the standard solution (for fine work diluted with six parts of water) already tabulated above; it is washed thoroughly in water and immersed for a few seconds in the three per cent. acetic acid solution. From that bath it is again washed, and finally fixed in fixing solution already described for the "N" non-strip paper and celluloid films.

STOPPING-OUT OR RETOUCHING.

Any stopping-out required on celluloid films, or the non-strip paper "N," may be done with Indian ink; but such work on the stripping paper "D" and the camera paper "K" must be executed with the stopping-out varnish used by process workers.

The foregoing description of this interesting method may seem to present some complications to the novice in photo-process work. Twenty-five years ago, the use of aluminium presented difficulties, but they were soon surmounted. Forty years ago the screen photo-process had much to contend with, but by constant practice that process has become an every-day practice. This method, however, is comparatively simple; it is presented by the inventors in an almost complete and finished state. The beginner in photo-process work should adopt it at once, and ultimately he and others will be surprised that glass negatives have not long since been superseded.

The methods for sensitizing metal plates, and the treatment of them after exposure for printing purposes have already been fully described above.

PAPER NEGATIVES.

In the various items preceding there have been occasional references to paper negatives. This is more especially

observable in the details of the Typon methods. The matter has been carried further by photographic supply houses, and such firms as Kodak, Ltd., and the Imperial Plate Co., have produced a photographic paper—a bromide—which can be used instead of glass or celluloid films. The use of paper necessitates arrangements for exposure. The practice of Typon is to place the paper between two sheets of glass, in the dark slide. Another method is to smear on a glass plate a thin solution of letterpress roller composition and smooth the paper on it. This brings the sensitive face into the same position as the sensitized face of ordinary negative glasses, and consequently does not require any special adjustment of the focus, as when two glass plates are used.

After exposure the paper readily strips from the plate for development. But some camera makers are now producing appliances specially for the exposure of "paper negatives."

The following details of the Kodak Negative Paper, "Kodaline," will explain the subject more effectively:—

Exposure for copying to the same size, 20 secs., at F11, by two 500-watt gas-filled lamps, two feet from copy.

DEVELOPER.

Metol	4 grammes.
Soda sulphite anhydrous ...	100 ,,
Hydroquinone	32 ,,
Soda carbonate anhydrous ...	60 ,,
Potassium bromide	4 ,,
Water	2,000 c.c.

Dissolve in the order as above. Time of development two to three minutes at 65°F.

Density of negative can best be determined by saturating the negative by wiping the back with an oil composed of eight parts white oil and one part petrol.

INTENSIFICATION.

If the original be poor in density of line, it may be advisable to reduce the time of development to one-half (1 to 1½ minutes). Should this fail to give the density, or if more density be required, the negative may be immersed for three minutes, immediately after fixing, without washing, in a bath of:—

Water	20 ozs.
Soda sulphite	4 ,,
Mercuric iodide	90 grains.

This solution must be kept in the dark. A negative prepared in this manner is not permanent, but if required it may be made much more permanent by again developing for three minutes in the same developer as above.

The fixing bath may be:—

20% hyposulphite of soda sol. to which add "Kodak" liquid hardener, or use the "Kodak" acid fixing salts.

Another paper for negatives is made by the Imperial Dry Plate Co., Ltd., and is known as "Imperial '99' paper for photo-mechanical work." This paper is of the bromide type, but its speed is two or three times faster than the ordinary bromide papers. From actual practice it has been found to give results as good as wet collodion for line work; and may be used with a fair measure of success for screen work of 75 lines. In the hands of experts who aim to get all that is possible by using this paper, some excellent work has been obtained. Such operators know how to use the developer to its greatest advantage, and have their own way in obtaining density.

This paper may be used in the dark slide for the direct production of the "paper negative" from the matter on the copy board. The developer recommended is:—

Metol	44 grains.
Hydroquinone	210 ,,
Sodium sulphite, crystals ...	3½ ozs.
Sodium carbonate, crystals ...	6½ ,,
Potassium bromide	21 grains.
Water up to	80 ozs.

The development should be complete in 1½ to 2 minutes. The paper is then well rinsed in cool water, and "fixed" in a bath of sodium hyposulphite 1½ lbs. and water to 80 ozs.

Negatives prepared in this manner are usually dense enough without intensification. But if experience shows they are not, then the negative, after washing from the fixing bath, should be intensified in the mercuric iodide intensifier.

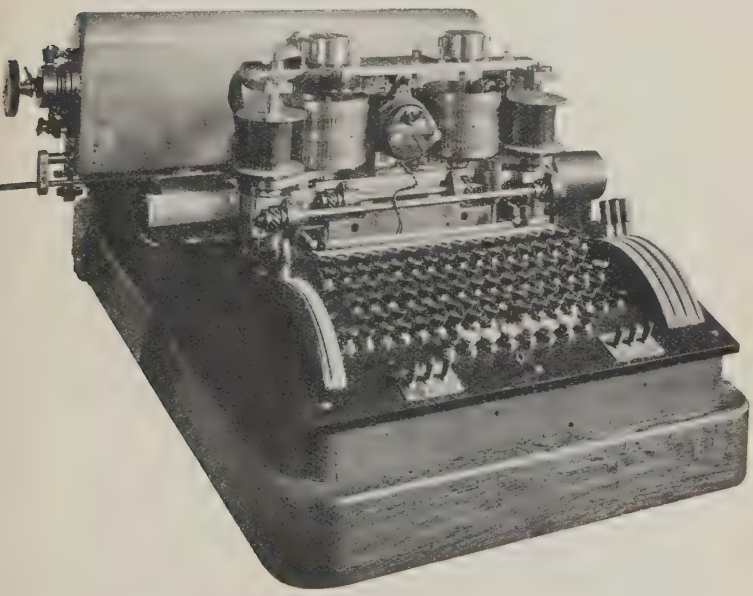
When dry, the paper negative may be smeared evenly on the back (the paper side) with a mere trace of olive oil, and an essential oil, to obtain greater transparency. To the lithographer who is about to use these negatives for printing

down, the use of oil seems rather risky, and no doubt the thoughtful operator will omit this expedient.

This paper can be obtained up to 40 in. wide, in sheets or rolls of any reasonable length.

THE AUGUST-HUNTER PHOTOGRAPHIC COMPOSING MACHINE, "THE THOTHMIC."

This machine is one of the greatest electro-mechanical conceptions in the printing trade. Even if it were not so perfect and capable of doing its work it might be regarded as



THE KEYBOARD, WITH FILM BOX AT THE BACK.

one of the marvels of the age. On the other hand it operates with such simplicity and precision that it is liable to be regarded by the majority just as a composing machine, whilst its intricacies and mechanics are overlooked.

This machine can be arranged to produce negatives or positives of type matter on a film from which originals may be photo-printed or "printed down" on sensitized metal plates ready for the printing machine—flat-bed or rotary. This is accomplished without the use of metal type.

The range of faces of type is at present thirty. Each of these complete founts can be produced in 90 sizes, that is from 6-pt. to 96-pt., rising by one point at a time. If required, 6-pt. and 96-pt. can be set in one line by an instantaneous change of focus. Further, any face—of the thirty different styles—can be brought into focus by tapping one or two keys on the keyboard.

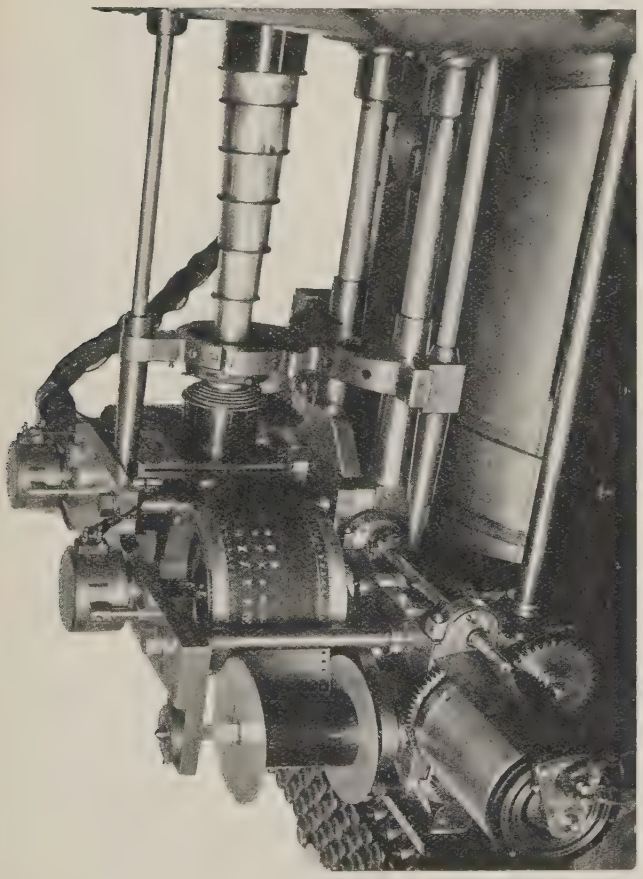
The master film which carries the thirty faces is prepared photographically from accurate drawings of the letters. The size on the film is 18-pt.; the variation from 5-pt. to 96-pt. is obtained by changing the focus of the photographic lens. Any change of size is made instantly by pressing a key on the keyboard.

The keyboard has six rows of keys for letters, signs and figures. There are extra keys for rules and leads; and special keys for fixing length of line, style of letter and the point size. A further device is for corrections. The determination of length of line actuates the justification mechanism which calculates the spaces and adjusts them in correct ratio.

This description, though brief, conveys sufficient details to make it clear that for all ordinary bookwork, periodicals and the like, the composition can be done by any good typewriter operator at a speed only controlled by the operator's ability. The whole of the composing, in any of thirty styles and in ninety sizes of each, is done on the keyboard.

The matter so composed is photographed on a sensitive film and removed for development. It is then arranged in position upon a sensitized metal plate, exposed, developed and rolled up ready for the first proof, or for the machine.

The possibilities of this machine are very great. Good operators will soon introduce new methods suitable to all the various requirements of illustrated books. It seems but a small gap to pass over before a machine for composing music will be made. The inventors have during the past six years taken notice of the advice of many experienced men, and introduced every known requirement to perfect the mechanism.



THE FILM DRUMS AND PHOTOGRAPHIC ENLARGING OR REDUCING APPARATUS.

It has taken a long time to inspire confidence in the leaders of the trade; but that has been done, and complete machines are now being made for use in printing offices.

The inventors are Mr. J. R. C. August and Mr. E. K. Hunter. The new works are at 158 Church Road, Upper Norwood, London, S.E. 19.

A. W. PENROSE & CO. LTD. AND HUNTERS LTD.

As these two firms have in the past dealt in many similar commodities, it will not be an unexpected event to have to record that Hunters Ltd. have purchased the whole business of Penrose & Co., as announced to the trade on 20th July, 1927. This combination, by the interchange of ideas, should have a beneficial effect in greater development of good apparatus.

CHAPTER XVIII.

ROTARY MACHINES FOR OFFSET AND TIN PRINTING.

GEORGE MANN AND CO.'S ROTARY ONE AND TWO-COLOUR, AND PERFECTING OFFSET MACHINES.

Ever since this firm started with the rotary type of lithographic printing machine in 1904, they have progressed year by year until even at the present time (1927) they have not finished in making developments and improvements in their well-known models of rotary offset machines.

The essential details of the earlier machines are the foundation of the later types. In many respects all these details have been the subject of mechanical improvement. The latest machines seem to possess all that ingenuity can suggest for their particular design of machine. Certain features introduced by them some twenty years ago have now become so well known that it is unnecessary to describe them at full length. A glance at the description of the machines, in 1912, in "Metalography," second edition, will show how most of the salient features and requirements of rotary direct and offset machines were known and provided for in the early products of this firm. And in the Printing Trades' Exhibitions of 1921 and 1925 were shown many models of rotary offset machines by this firm and others, in which it was apparent that the theory of construction had been put into a practical form by a variation of mechanical devices. It is in this respect that the machines of Messrs. Mann & Co. stand apart from most other firms.

The rotary offset machines made by this firm are the single-colour and the two-colour machines, in ten sizes, from demy to eight-crown, and the "Baby" single-colour machine for demy folio paper; also the "Standard" and "Rapid" types of tin printing machines for double demy plates. They also make the Direct Rotary in any sizes required.

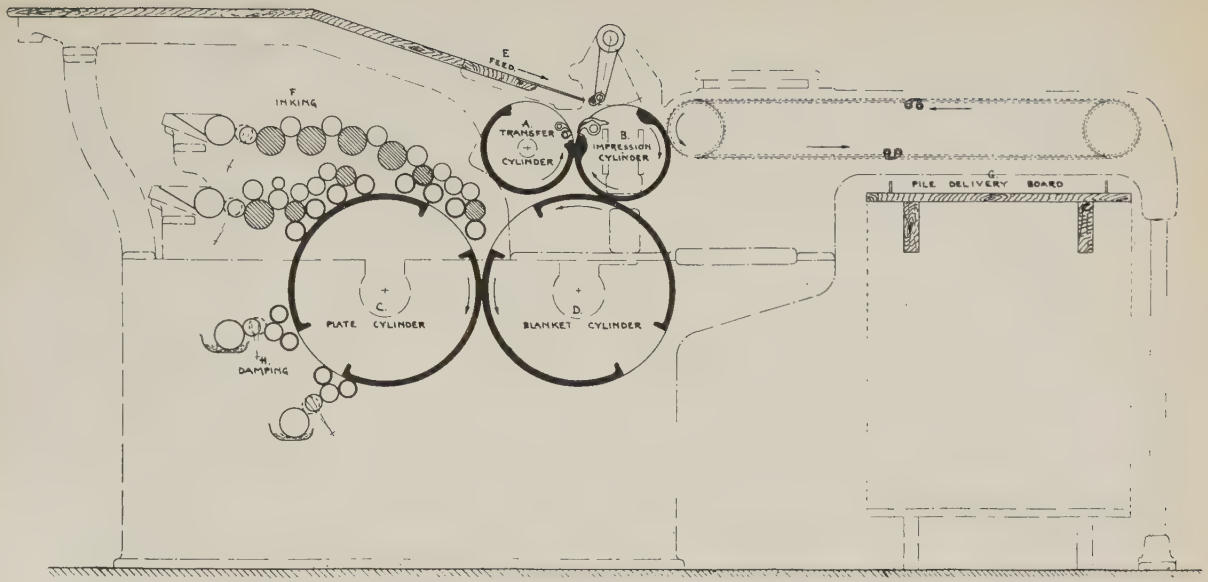
THE TWO-COLOUR AND PERFECTING ROTARY OFFSET MACHINE.

This machine has been the subject of the most attention in later times, and the final machine of this type has quite recently (Nov. 1926) been placed before the trade. It is one of the most improved machines that this firm has produced, and the details of it show the extent to which the printers' requirements have been met. In brief, the points of construction which have received this attention are:—(1) Swing feed, (2) damping, (3) inking, (4) delivery and (5) a comprehensive trip; all of which are to give smooth working throughout the machine and to give an increased speed of 30 to 50 per cent. over their previous machines. These points require a little explanation as follows:—

Swing Feed. The moving feed has been replaced by a stationary board and turn-over grippers are no longer used. The actual feed to the main impression cylinder grippers is carried out by swinging arms mounted over the impression cylinder carrying the bar on which the feed grippers are mounted. This bar is swung to the sheet of paper and at the moment of contact the grippers close smoothly and take the paper to the cylinder grippers at the same speed that the cylinder rotates. This mechanism secures both the evenness and firmness necessary for register at any speed required. Any automatic feeder can be attached to these machines: the firm itself makes the Mann automatic feeder.

Damping. The complete damping apparatus is duplicated so that each plate has separate dampers. To effect this the plate dampers are actuated at the end of each plate to rotate on the rider to a small extent and leave the plate; falling back into damping contact when the cylinder brings the plate into its proper position. In the interval the dampers of the other unit have damped the other plate and rise at the end of such plate. The plates on the cylinder are accessible for inspection as the damping units are placed towards the lower circumference of the cylinder in a good position for proper attention. These two units can be moved by a hand toggle from the cylinder when required; they have very fine adjustments for the water supply and are kept clean by brass riders.

Inking. In running the machine the rollers are only lifted at the gaps in the cylinder, and in two-colour machines the rollers rise and fall in pairs at the gaps, but do not lose touch



Basic Diagram of Two-Colour and Perfecting Rotary Offset Machine.
George Mann & Co., Ltd.

with the distributors. In running up the colour the inkers can be raised from the plate by a convenient hand lever. The oscillation of the steel distribution rollers can be varied from zero up to approximately $1\frac{1}{2}$ in. In changing colour the duct knives can be readily removed, and replaced without altering the setting.

In the two-colour machines the two complete inking units are at the top of the plate cylinder, conveniently placed under the feed board.

Delivery is made on a pile at the end of the machine and can be easily removed. It has the well-known features of non-contact on the printed side, and that side is delivered upwards, the speed of the delivery chains being reduced at that time.

The Trip—termed the New Universal Trip—is similar to other well-known makes in so far as it separates all the cylinders, stops the ink and water supplies and lifts the inkers from the plate. It is actuated and released by the pedal on the feeder's platform or by the automatic feeder. Every part has been made with precision and gives smoothness of working.

Cylinders. The machines of this firm have always been run with three main cylinders only. This principle is virtually carried out in the two-colour machine. The plate cylinder carries two printing plates, and the blanket cylinder has two surfaces on which blankets are tightened by tension devices at both the front and back to obtain uniformity of surface. The impression cylinder is only half the diameter of the other two; it, therefore, makes two revolutions to collect the two colours on the paper, which is later delivered by the transfer drum.

PERFECTING.

The "Standard" Two-colour Rotary Offset Machine, just described, can be used as a perfecting machine by making certain small adjustments. These adjustments have to be made to (1) a spring plunger-controlled lever inside the impression cylinder, (2) to a spring plunger-controlled lever which fixes the position of one of the gripper operating pins, and (3) to the gear which drives the chain sprockets.

By this alteration the timing for the opening of the grippers is changed. The grippers thereby remain closed on the first revolution of the impression cylinder and a sheet is not

taken. As the impression cylinder has a rubber blanket on it when used for perfecting, thereon the first revolution in contact with the large blanket cylinder, a print is left on the impression cylinder. The sheet of paper is then taken by the grippers and by the second revolution of the impression cylinder in contact with the second blanket on the large blanket cylinder, a print is made on the paper from the second blanket, and at the same time receives a print on its under side from the blanket on the impression cylinder.

The printing plate, which bears the matter for the back of the paper, must have that matter reversed from right to left as on ordinary direct lithographic printing from stone. The inking for perfecting in this way must be adjusted to allow for the double transfer operation which takes place.

The advantage of perfecting is quite obvious in both large and small printing works.

The speed attainable for quad crown or quad demy on the single-colour machine is an average of 3,200 per hour, and on the two-colour machine it is about the same. The increased speed is largely due to a reduction in the diameter of the cylinders.

In reconstructing all the machines on the model of the 1926 two-colour offset rotary, the latest improvements have been embodied. Each important part is numbered, so that replacement can be easily effected.

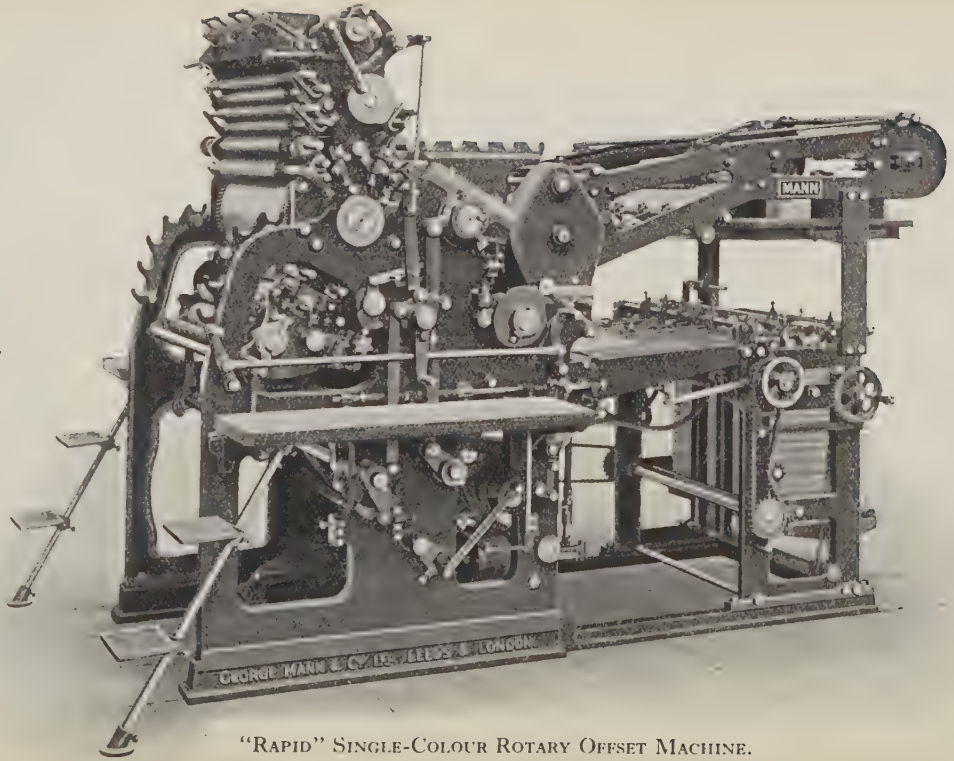
"STANDARD" SINGLE-COLOUR ROTARY OFFSET MACHINE.

The earliest form of this machine was produced in 1908, and its more improved model, along with the early design of the two-colour offset machine, in 1910. Since then improvements have been made year by year in both cases, which should within a limited period bring the two machines as nearly similar as the different purposes will admit.

The single-colour machine is the embodiment of the original patent for three cylinders only.

The feature of having the impression cylinder half the diameter of the plate and blanket cylinders, did not necessarily decrease the speed, as the printing plate cylinder took the drive and could be run at any desirable speed and produce an impression at each revolution.

The single-colour machine has the ideal system of inking, in so far that the inkers have ample time to recover from one



"Rapid" Single-Colour Rotary Offset Machine.
George Mann & Co., Ltd.

rolling up to the next, as well as an ink slab to assist distribution. This latter desideratum can scarcely exist in a two-colour machine with two plates on one cylinder. However, the two independent inking units each retain ample time for recovery after each rolling, as the rollers for one plate are lifted clear of the other and are refreshed with ink before again rolling their own plate; i.e., for more than half a revolution of the cylinder.

The feeding, formerly to lays on a rising board, has been altered in later single-colour machines to the system now employed on the two-colour already described, on which a swing feed replaces the moving board and turnover grippers. As before, the lays are very sensitive and capable of fine adjustment.

Note.—The lays proper are not checked at any time, but when machines are automatically fed there is a mechanism which checks the whole machine whenever a sheet fails to reach the lays.

Whereas, formerly, the cylinders were driven mainly by contact while printing, the modern practice is to rely less on the contact pressure and more on wider and very accurately cut gears, which assure accurate register and perfect printing of photo-litho. work when very little pressure is needed.

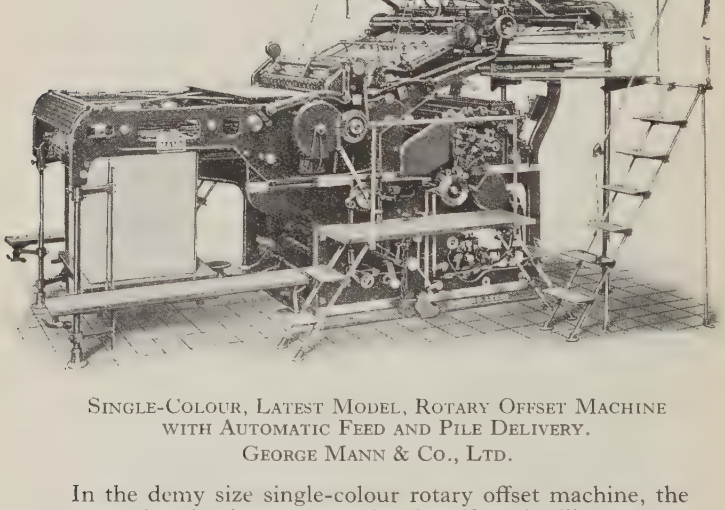
The adjustment of pressure between the impression cylinder and blanket cylinder is effected by springs, on the same principle as the Mann flat-bed machines. The plate and blanket cylinders are set for ordinary pressure, and only require occasional attention by means of coupling arms outside the machine. The impression makes two revolutions, one of which takes the impression while the other revolution is instrumental in securing a delivery printed side up. The chain and gripper delivery being slowed down at the moment of the fall of the sheet on to the "pile" delivery attachment. The printed sheets are at a convenient height for inspection.

Both the damping and inking units are of the same character as on the two-colour machine. It may be added that distributing drum runs at a high speed and has a reciprocating motion.

The check or trip is actuated by a pedal on the feeder's platform, and throws the cylinders apart, lifts the inkers and stops both the ink and water supplies. The three last checks can be effected separately by hand levers.

The drive is by the single pulley friction clutch drive, and smoothness of running is secured by the use of ball bearings at each journal.

The slow-motion for moving the cylinders forward in short distances at a time is controlled by several pedals, each one being capable of actuating the mechanism.



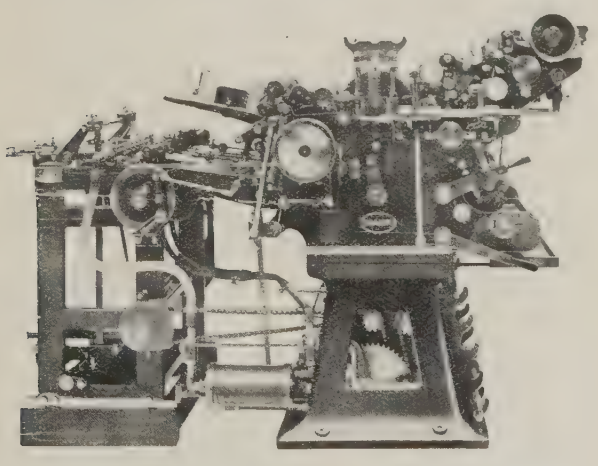
SINGLE-COLOUR, LATEST MODEL, ROTARY OFFSET MACHINE WITH AUTOMATIC FEED AND PILE DELIVERY.
GEORGE MANN & CO., LTD.

In the demy size single-colour rotary offset machine, the construction is the same as in the "Standard" machine, described above, with the exception of the delivery. This is effected by stripping the impression from the cylinder and running it between a steel roller and rubber runners, from which it is "shot" on to the delivery board.

THE "BABY" SINGLE-COLOUR ROTARY OFFSET MACHINE.

This is the equivalent in lithographic printing to the platens used in letterpress. The speed of production is usually 3,000 to 3,500 per hour when hand fed, and when fitted with an automatic suction pile feeder the output may be from 4,000 to 5,000 per hour. In both cases register is maintained.

In construction it resembles the "Standard" rotary offset machine already described. The notable differences are: that the blanket cylinder is mounted above the impression cylinder, thus facilitating cleaning and removal; the feeding is done face downwards, to front and side lays on the board, and the printed sheet is delivered face up on a board just above the feed board.



THE "BABY" SINGLE-COLOUR ROTARY OFFSET MACHINE WITH "MANN" AUTOMATIC PILE FEEDER.
GEORGE MANN & CO., LTD.

These machines have had a large sale—several hundreds are in use and as many as ten are in one printing office.

The "Rapid" offsets are similar in principle to the "Baby" offset, and are in fact larger sizes of this model with an in-built pile feeder.

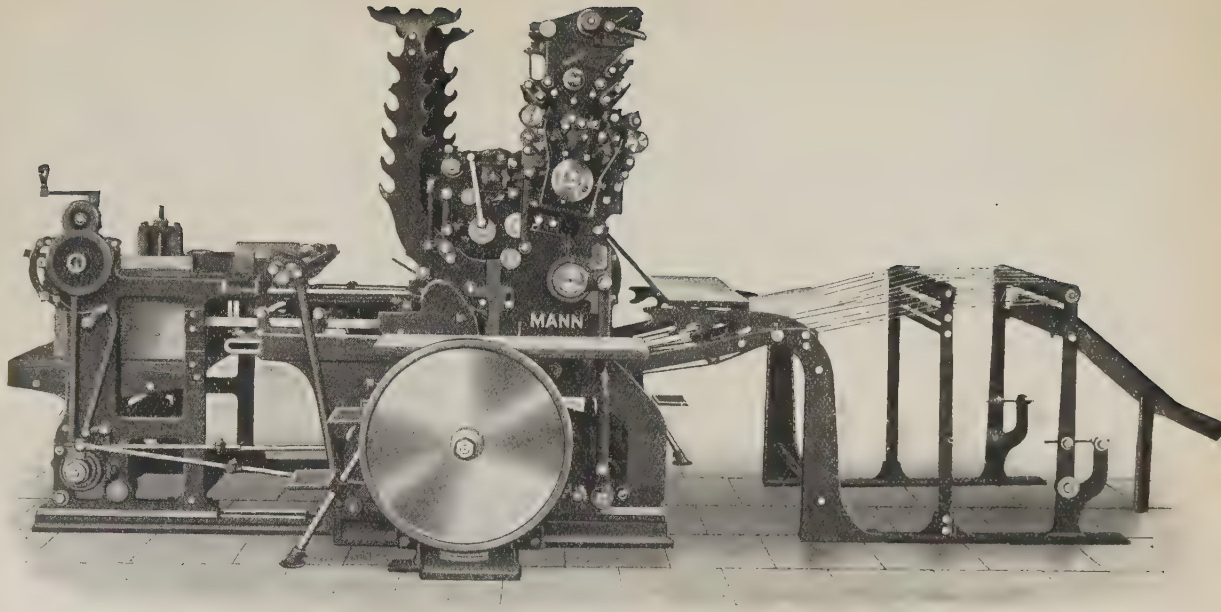
The spaces occupied by these machines are:—"Baby" (demy folio), 6 ft. 4 in. × 4 ft. 4 in.; "Baby" with feeder, 7 ft. 3 in. × 4 ft. 9½ in., and both require 1½ h.p. motors. "Two-colour" quad crown, 15 ft. 2 in. × 9 ft. 6 in., requiring 7 h.p. motor; "Two-colour" eight crown, 16 ft. 6 in. · 11 ft. ½ in., 12 h.p. motor. "Standard" one

colour double crown, 12 ft. 0 in. × 8 ft. 2 in., 3 h.p. motor; "Standard" one-colour eight crown, 17 ft. 6 in. × 11 ft. 0 in., 7 h.p. motor. One-colour "Rapid" double crown, 7 ft. 8 in. × 10 ft. 0 in., 3 h.p. motor, with "Mann" automatic feeder.

TINPLATE ROTARY OFFSET MACHINE.

This firm showed the first rotary offset printing machine for tinplates at the Printing Trades Exhibition of 1904, when the judges (of whom the writer was one) could not make a definite decision because the machine was not in operation, but the firm was awarded a silver medal for the novelty of its production.

This machine was built on the same principle as all the succeeding offset machines made by this firm, with three cylinders set L fashion; but in this tinplate machine the three cylinders were of the same diameter. The same type of machine is still made, and has been installed in many tinplate printing firms. More recently this firm has made a new type of machine for tinplate printing, in which the three equal cylinders are arranged almost vertically, one above the other, in order to obtain greater speed and improved delivery, as well as a flat, semi-automatic feed. This type of machine is known as the "Rapid." In this machine the printing plate cylinder is at the top with the inking apparatus over the top of it and the damping at one side. The rubber-blanket cylinder is vertically below this and the impression cylinder below about half a diameter out of the vertical line. This arrangement allows the tinplate to fall conveniently on to the conveyor for transport to the racks or even to the ovens. The feed board rises automatically to allow the feeder to push a tinplate to the feed rollers, which carry it to the first lays and grippers. The side lays come into operation and travel with the plate until it is taken by the impression cylinder for printing. This arrangement reduces the amount of handling and generally gives great advantages over the single upright hand feeding in the original "Standard" model, where the tinplate is subjected to much greater curvature during printing. With these differences in type and from the paper printing rotary offsets, all that is different has been mentioned. The remaining mechanism throughout is the same as that of the "Standard" single-colour rotary offset machine for printing on paper.



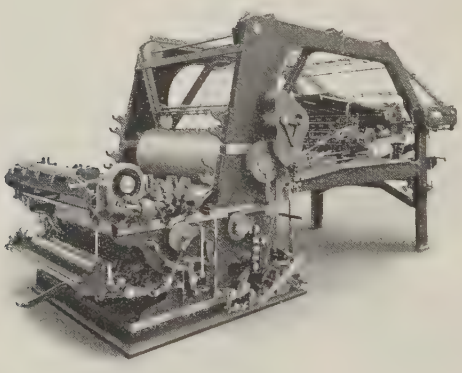
"Rapid" Rotary Tinplate Decorating Machine. George Mann & Co., Ltd.

Spaces occupied by these machines :—"Standard," 7 ft. 8 in. × 7 ft. 6 in., requiring 2½–3 h.p. motor; "Rapid," 8 ft. 0 in. × 12 ft. 3¾ in., 2½–3 h.p. motor.

Both machines will print plates up to 36 × 25½ in, and the lengths given do not include the conveyor. The "Standard" machine can be driven at a speed of 2,000 per hour, and the "Rapid" at 2,500 per hour.

R. W. CRABTREE AND SONS' ROTARY OFFSET MACHINES.

This firm, hitherto known as makers of rotary letterpress machines, now makes offset and direct rotaries for lithographic printing. Some few years ago Mr. A. B. Evans left Messrs. George Mann & Co. and joined Messrs. Crabtree. He had

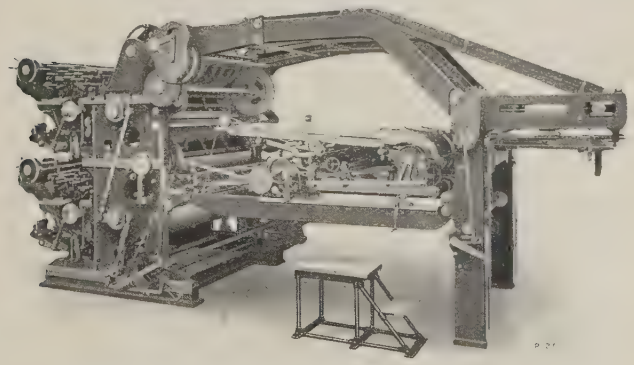


Single-Colour "Ensign" Super-Offset, with Cross Feeder.
R. W. Crabtree & Sons, Ltd.

been one of the strong moving spirits in the making of the offset machine, and it was he who had so much to do with the first rotary tinplate printing machine shown at the Exhibition of 1904, and with its subsequent development for printing on paper by offset. This machine when finally perfected was patented by Mr. Evans, and manufactured by Messrs. George Mann & Co., in 1907.

Following this invention Mr. Evans patented the multi-colour offset machine, which held its premier position almost without competition until 1914.

All two-colour offset machines at that time were built on the two-revolution principle, but Messrs. Crabtree have been the first to build—under Mr. Evans' direction—a two-colour machine on the single-revolution principle, which has clearly shown that greater speed production, with less wear on the machine, can be obtained by that form of mechanism.



Two-Colour "Ensign" Super-Offset, with Rotary Auto-Feeder. R. W. Crabtree & Sons, Ltd.

The rotary offset machines made by Messrs. Crabtree and Sons include single-colour and two-colour machines in thirteen sizes, from demy folio to extra eight crown, all of which are known by the name "Ensign," and of which the demy and demy folio are termed "The Little Ensign."

They also make direct rotary litho. machines in all convenient sizes and rotary tin-printing machines in double demy and quad crown sizes.

All these machines are built on the original model with the plate and blanket cylinders placed parallel horizontally, and the impression cylinder above the blanket cylinder, leaning forward half its diameter, and, therefore, allowing the feed

board to approach the impression cylinder at its lower curvature. The three cylinders have equal diameters. The inking is located above the plate cylinder, and the feed is at the other end, with the delivery carried upwards from the impression cylinder, thus leaving the inking apparatus open

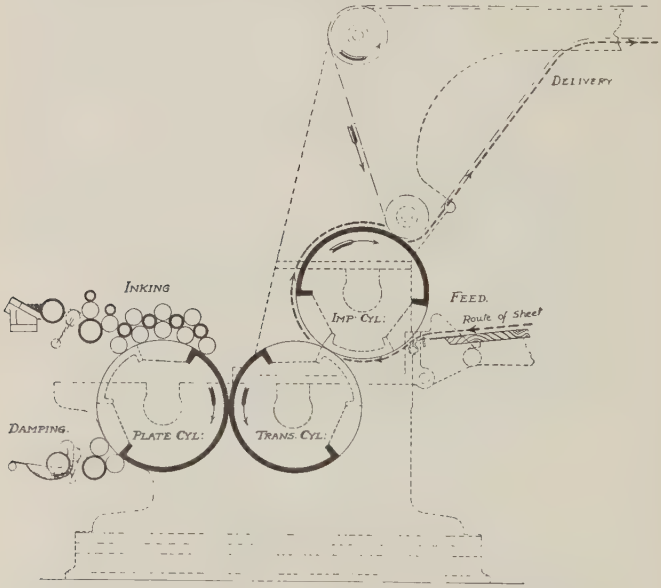


DIAGRAM OF SINGLE-COLOUR "ENSIGN" SUPER-OFFSET, showing position of Damping, Inking, Feed and Cylinders; and also Route of Sheet.
R. W. CRABTREE & SONS, LTD.

to close inspection, with access to the blanket cylinder. The dimensions of the single-colour rotary offset machines are:— Demy, height 5 ft. 0 in., length 6 ft. 5 in., breadth 4 ft. 4 in.; motor h.p. 1 to 1½; double crown, height 7 ft. 0 in., length 11 ft. 0 in., breadth 8 ft. 2 in., motor h.p. 3; eight crown, height 8 ft. 9 in., length, 21 ft. 4 in., breadth 11 ft. 0 in., motor h.p. 7.

Similar particulars of the two-colour offset machines are:— Demy, height 7 ft. 0 in., length, 6 ft. 5 in., breadth 4 ft. 4 in., motor h.p. 1½ to 2; double crown, height 7 ft. 0 in., length 11 ft. 0 in., breadth 8 ft. 2 in., motor h.p. 4; eight crown, height 10 ft. 3 in., length 21 ft. 4 in., breadth 11 ft. 0 in., motor h.p. 12.

The two-colour rotary offset machine has five cylinders, viz., two plate, two blanket, and the one impression cylinder.

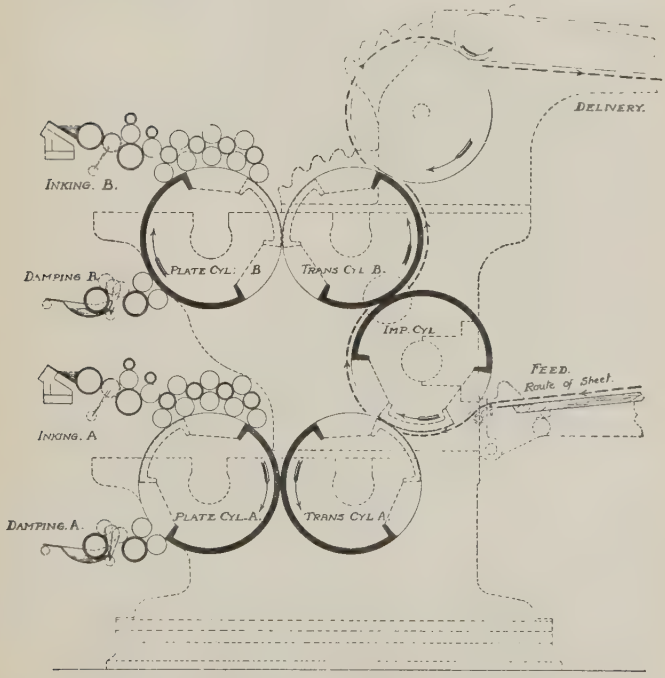
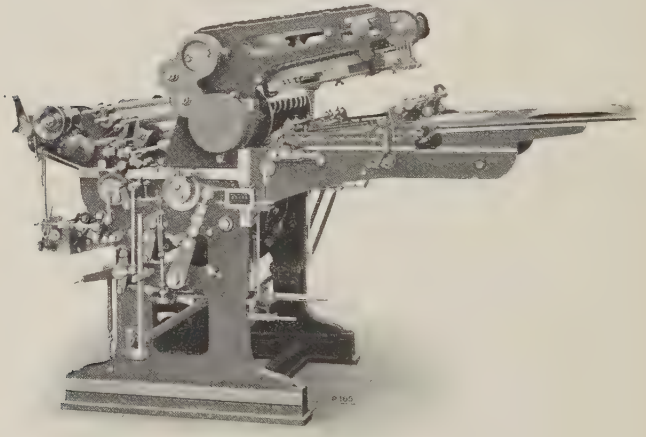


DIAGRAM OF TWO-COLOUR "ENSIGN" SUPER-OFFSET, showing position of Damping, Inking, Feed and Cylinders; and also Route of Sheet.
R. W. CRABTREE & SONS, LTD.

The plate and blanket cylinders are mounted vertically above one another, with the impression cylinder at the feed end in contact with both blanket cylinders and projecting half its diameter from them.

Generally speaking, these machines can be attended to for all ordinary running operations from the floor level, and from raised platforms when required, on the taller machines.



The "Little Ensign" Super-Offset, with their Semi-Auto Feeder and Positive Delivery. Marks I and II. Demy Folio and Demy.
R. W. Crabtree & Sons, Ltd.

Apart from the delivery, these machines have a similar compact and handy appearance to those placed on the market from 1908 onwards. The question of delivery has been dealt with by returning the sheets on conveyors well up over the feed, leaving ample room for feeding by hand, or the instalment of any automatic feeder. This method adds but little to the length of the machine, and has the special advantage that all stock is dealt with from the same end of the machine, so that only one gangway is required for movement of stock.

THE "LITTLE ENSIGN."

This model has been made for work not exceeding demy, at specially high speed. When worked for demy paper it gives an average of 3,600 per hour, and demy folio, 4,000 per hour.

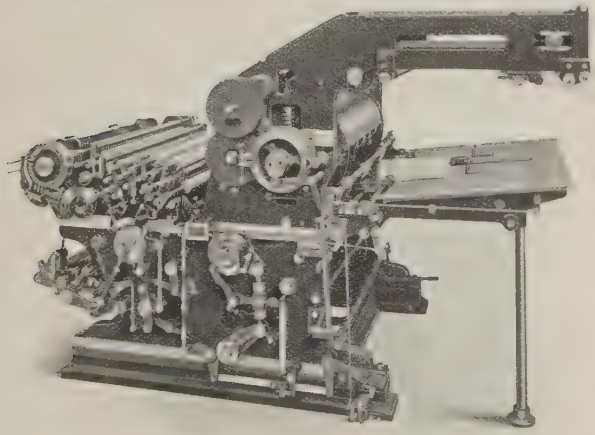
The delivery is on a board over the feed board and suitably low for inspection.

In construction it is a small copy of the standard machine, in every particular and with every improvement of the single-colour rotary offset machine. It is very easily handled and the parts are easy of access.

It may be fitted with an automatic or semi-automatic feeder to obtain the maximum output.

ROTARY OFFSET TINPLATE PRINTING MACHINE.

This machine, the standard size of which is the double demy, is built to the same model as the Super Offset Single-Colour Machines, except the special details for handling tin



SPEEDY "ENSIGN" ROTARY TIN-PRINTER, WITH PATENT DOUBLE HAND-FEED. MARK IV. DOUBLE DEMY.

R. W. CRABTREE & SONS, LTD.

sheets. The feed is semi-automatic by two feeders, and the lays on the board secure perfect register even though the plates may have uneven edges. The delivery is by chains and grippers which catch the tinplate edge after printing, and carry it to the conveyor over the feed board. These machines are easily managed from the floor level, and the delivery is away from the inking and well up overhead as not to interfere with attention at the inking end, or the feed board. The output, with semi-automatic feeder, may be 3,000 per hour.

The dimensions of the machines are much the same as the single-colour offset machine already given, and the power of the motor required is 3 h.p.

The working particulars of these machines are practically the same in all cases, except that in the two-colour machines the essential parts are duplicated. The details may be summarized as follows:—

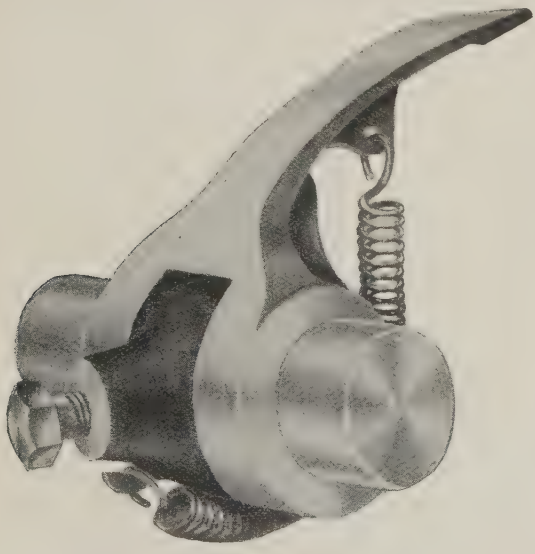
The Feed is at a height of 3 ft. 9 in. in the demy folio, gradually increasing to 4 ft. 2 in. in the largest machine. It may be by hand or mechanical feeder, and the feeders which are suitable for attachment are "The Cross," "The Dexter," "The Slogger," "The Camco or Rotary," "The Universal" automatic feeders, and "The Ensign," and "H.T.B." semi-automatic feeders: while "pile" or other automatic delivery is equally applicable.

The whole feeding apparatus is closely comparable to that of a stop-cylinder press with a stationary board. The delivery is at the feed end of the machine, at a suitable height from the floor, and in transit of the sheet nothing touches the printed side of the sheet. An automatic brush smooths the paper, and can be adjusted locally to overcome waves in the paper. The feeder in checking the cylinder also checks the lays and grippers; this being a novel feature in rotary machines.

Damping is done by two rubber cored damping rollers, with seamless covers, and fine moleskin; the rider reciprocates, and is made of brass. The feed roller is of the same construction, and collects the moisture from a covered roller at the duct. The supply of water can be regulated to the finest point.

The damping roller sockets are of the eccentric type, which assures easy and quick adjustment; and when the cylinders are checked the water feed is stopped.

The inking is by the now well-known pyramidal form introduced by Mr. Evans when offset rotaries were designed, with reciprocating riders, the amount of lateral movement being adjustable to any desirable degree. The stack of rollers in quad crown and larger machines is so arranged that there is an intermediate distribution between the first and last pairs of inkers to counteract the water taken up by the



Self-Adjusting Spring Gripper (provisionally protected).
R. W. Crabtree & Sons, Ltd.

first pair. Every roller is easily removable without any unlocking devices; and they run in patent eccentric sockets, giving a ready means of sensitive adjustment. The inking rollers bear on the plate by their own weight. The inkers and ink feed are thrown out of action when the cylinder is checked, but may be returned into position by the operator.

The plate cylinder has combination clamps to facilitate the swing and side register operation. The ink and water

ducts are set vertically above one another, no inverted inking being present. This arrangement allows wide space for the inspection of the plate.

The transfer or blanket cylinder is readily accessible; and runs in double eccentric journals, giving separate adjustments to the plate and impression cylinders.

The impression cylinder has a rubber blanket covering to assist in good printing on different thicknesses of materials. The grippers do not grip on the blanket, and carry the paper all through the printing. As they are of a special spring model it renders setting very easy. This form of mechanism prevents flat paper from creasing.

The cylinder check is by pedal and simultaneously checks roller lift, ink and water feeds, and sheet feed; but in each case there is a means of disconnecting the check.

The slow motion is fitted to double crown and larger machines; it is actuated by hand and pedal, and releases the brake.

FURNIVAL AND CO.'S ROTARY OFFSET AND DIRECT MACHINES AND TINPLATE PRINTING MACHINES.

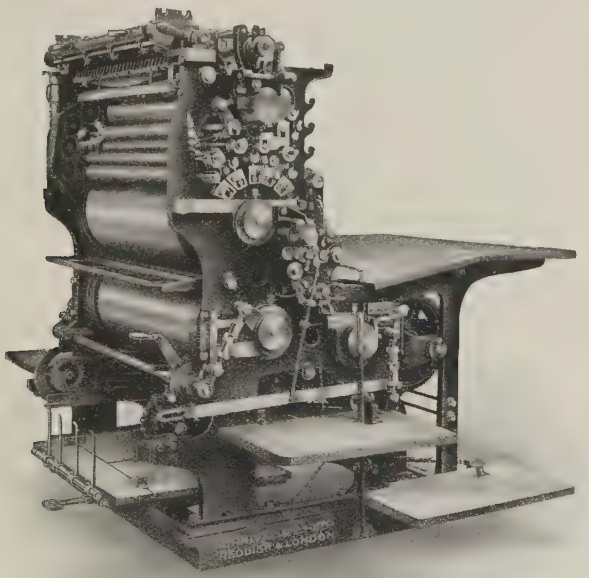
It is well known that in the early days of printing upon tin, by the offset method, that Messrs. Furnival were the outstanding makers of machines for that purpose. At that time as at the present the flat-bed type of machine has been used; but the general principles of offset printing have been the same, and this firm, after perfecting a direct rotary printing machine, had only to go one step further to produce the present form of offset rotary machine for printing on paper.

The general build of this machine resembles the offset rotaries of America and France. The makers, however, have altered several of the details of structure to overcome certain disadvantages which characterized the earlier models of this type of machine.

The machine is built in a framework of that rigid character which has always been a feature of this firm's machines.

The three cylinders are of the same diameter, so that every revolution produces an impression. A uniform speed of 4,000 per hour can be maintained. These three cylinders are thrown out of contact with one another by a lever actuated by a pedal on the feeder's platform and at the same

instant the inking and damping apparatus are also thrown out of action. The blanket cylinder can be moved separately by a hand lever into contact with the plate cylinder when the cylinders are checked. The ease and accuracy of these adjustments are to a large extent due to the use of eccentric journals for the impression and blanket (transfer) cylinders.

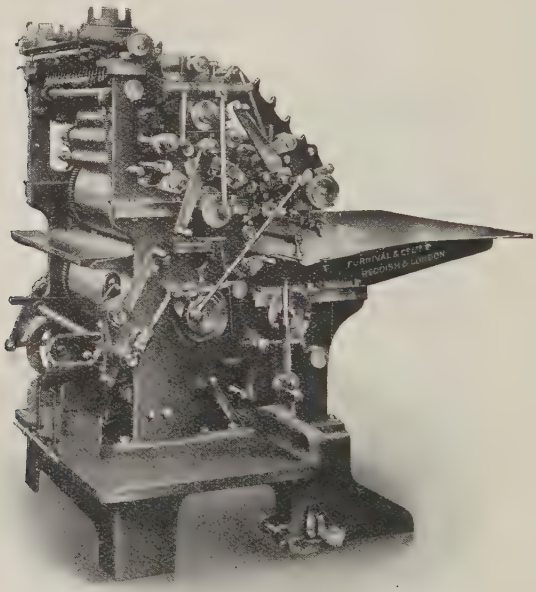


Single-Colour Rotary Offset Machine.
Furnival & Co., Ltd.

The impression cylinder has no covering: the transfer cylinder has a simple and efficient device for stretching the blanket with uniform tension.

The inking is ample for all classes of work, and the damping appliances are so placed that automatic feeders can be fitted to the machines, and so arranged that the water supply can

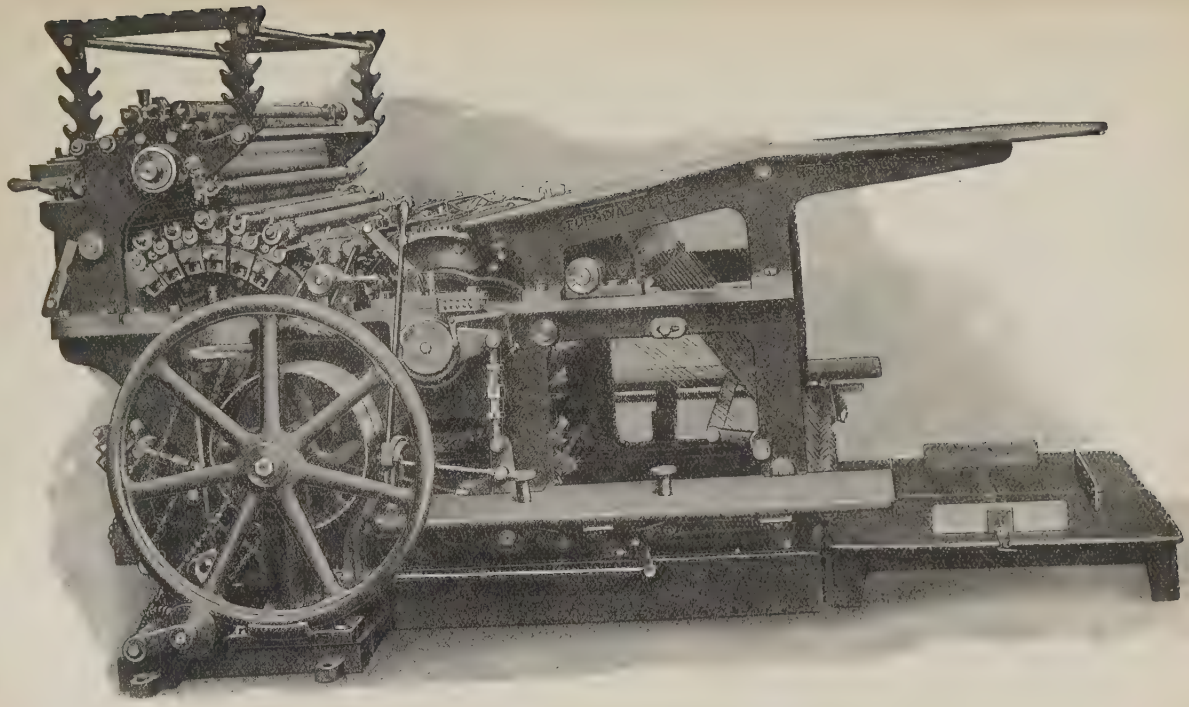
be regulated from nil to maximum while the machine is running, according to the requirements of the work being printed, and they are so planned that they do not protrude unduly over the feed board.



"B" Model Rotary Offset Machine.
Furnival & Co., Ltd.

The sizes of the single-colour offset rotaries are:—Demy, double crown, double demy, quad crown, quad demy, together with the special "B" model to print a "medium" sheet 24 in. by 18 in., which has been built to meet the requirements of the commercial printer.

It is a very strongly built press, being compact with all adjustments within easy reach of the operator.



DIRECT ROTARY PLATE PRINTING MACHINE. FURNIVAL & CO., LTD.

The register and impression are perfect, as also are the inking and damping, and the speed is only limited by the capacity of the feeder, whether hand or automatic feed.

FURNIVAL TWO-COLOUR OFFSET PRESS.

This press has been specially designed to provide a two-colour offset press embodying all the valuable features of their latest single-colour offset machines, and a delivery placed at a convenient height to give the operator a full view of the printed matter as it is being delivered, without the printed sheet passing round a drum, along delivery sticks, strings or tapes, and so obviates any possibility of smearing the printed surface.

In this machine there are six cylinders in all.

The large impression cylinder makes one revolution per cycle of the press—then there are five cylinders half the diameter of the impression cylinder, arranged in the following manner:—

A transfer cylinder placed on the delivery end is simply used for making possible this much improved type of delivery.

Beneath the feed board there are two pairs of cylinders, i.e., two blanket cylinders in contact with the impression cylinder, and two plate cylinders in contact with the blanket cylinders. The inking and damping rollers are grouped around each plate cylinder.

The distribution of the ink and the inking of the plate are more than ample for every class of work, inasmuch as there is constant double rolling for each impression.

Another important feature is that an entirely separate damping apparatus is provided for each plate, and these are placed in most accessible positions and can be regulated with the greatest ease. A simple adjustment is provided for damping the plate once or twice for each impression where this is found necessary. The water supply can also be regulated from nil to maximum.

The plate and blanket cylinders are arranged at convenient heights and are just as easily accessible as in the single-colour machines.

Special provision is also made for adjusting one cylinder with the other either longitudinally or circumferentially, thus ensuring that the design on the one plate will pitch exactly in position with that on the other plate.

A slow turning forward movement is put into operation by the mere depression of a pedal at the plate cylinder end of machine, which is most helpful to the operator when fixing plates or blankets.

The cylinder shafts are mounted in strong eccentric bearings which are adjustable for pressure, and can be easily set by means of coupling nuts with left and right hand screws in them.

This method ensures the centres of the toggle levers and coupling rods being in dead straight line, and so forms a lock which will resist the heaviest impression.

The sheet is fed to lifting lays outside the impression cylinder. It remains in contact with the lays until the grippers have actually closed on the sheet. The lays are then lifted and fall into position again as soon as the tail edge of sheet has passed. This gives the maximum of time for laying the next sheet.

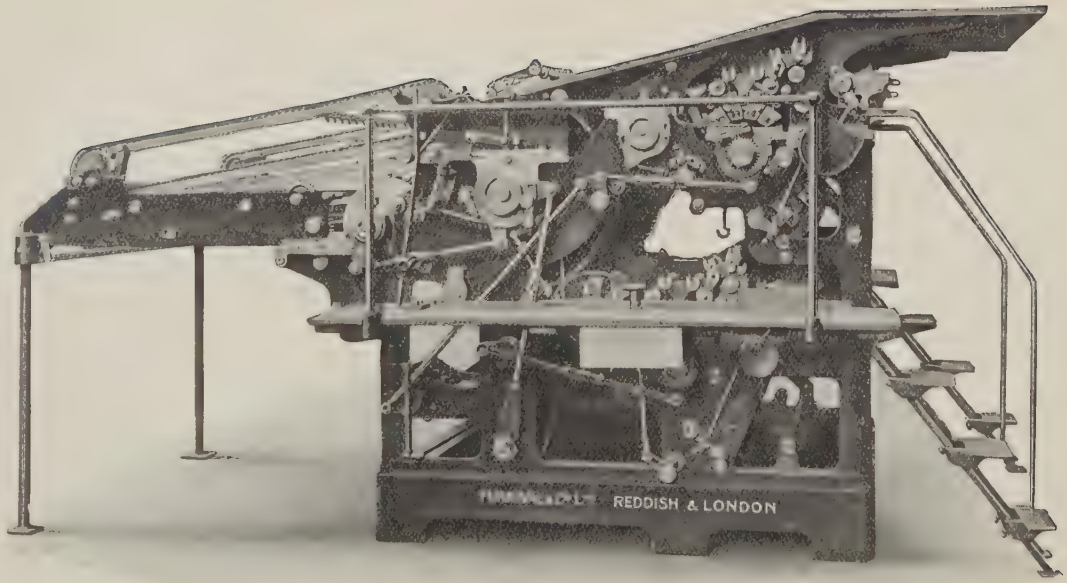
The sheet passing round is then taken by the transfer cylinder grippers and after one revolution of this cylinder, is transferred to the second set of grippers for its impressions from the two blanket cylinder surfaces. The sheet then passes under the feed board which is slightly lifted and is taken by the delivery grippers, carried forward on to a set of tapes, which, winding from underneath, allow the printed sheet to fall gently on the delivery board.

Absolute register is obtained during the transference of the sheet between the impression and transfer cylinders, as in addition to the sheet being "nipped" between the surfaces, it is held securely by both sets of grippers for half-inch or more during the "nip," so that the sheet is under perfect control during transference. From this it will be seen that it is impossible for a disturbance of register to take place.

The machine is arranged to take either paper or cards, and when changing from one to the other, register segments and split gears are provided which are easily adjusted and so eliminate all "back-lash" between the teeth of the gears.

By depressing a pedal on the feeder's platform, the cylinders are automatically separated and checked.

When the cylinders are checked, the inking rollers are automatically lifted and the water duct and ink duct supplies are also checked.



Two-Colour Rotary Offset Machine
Furnival & Co., Ltd.

The plate dampers can also be lifted from the plate cylinders by the simple movement of a handle lever placed in a very convenient position.

Sizes:—Double demy, paper size 36 × 24 in.; size of design 35 × 23 in.; length 12 ft. 6½ in.; width 8 ft. 4½ in.; height 7 ft. 5 in.; motor 4 h.p. Quad crown, paper size 42 × 32 in.; size of design 41 × 31 in.; length 14 ft. 5½ in.; width 9 ft. 5½ in.; height, 9 ft. 0 in.; motor 5 h.p. Quad demy, paper size 48 × 36 in.; size of design 47 × 35 in.; length 14 ft. 5½ in.; width 9 ft. 11½ in.; height 9 ft. 0 in.; motor 5 h.p.

THE L. AND M. OFFSET ROTARY MACHINE.

The Linotype & Machinery, Ltd., have built three sizes of offset rotaries which vary very slightly in construction, such variation being only in a detail of a minor character.

In general appearance it is a convenient compact looking machine. The largest size is for printing a sheet 52 × 37½ in. and its foundation measurements are 5 ft. 8¾ in. in length by 7 ft. 11 in. wide, with full overall measurements of 13 ft. 11 in. × 10 ft. 7 in.

This type of machine has been constructed for some years, and includes the high developments in mechanical skill which are found in other makes, as well as others which are the subject of proprietary patents and are therefore exclusive.

The impression and transfer cylinders make two revolutions for each revolution of the plate cylinder, which is of large diameter and, therefore, gives the inking rollers time to be refreshed between the impression intervals. The inking arrangements are ample for good sound work, and no less than nineteen rollers and riders are employed from the duct to the plate. The damping apparatus is placed as low as possible and has very fine adjustments.

The pile delivery is of the gripper chain type, with means for adjusting the brackets along the side chains to compensate for any undue stretch of the chains themselves. At the moment when the paper is taken by the delivery grippers from the cylinder, the shafts carrying the grippers are held perfectly rigid. To meet the variations required by different weights of paper, and the speed of running, there are suitable cam adjustments at the front end of the delivery; and as the delivery grippers are held open for some time after the sheet is released, they do not interfere with the fall of the sheet on

the pile. The speed of the delivery chains is also reduced at the time the sheet is let go, preventing any smear or rub on the previous sheet, and also obviating the danger of breaking the edge of the paper against the front stops. The pile board is automatically lowered by sprockets working in conjunction with the chain supports of the board. The feed mechanism can be adjusted to the thickness of the paper used. The whole delivery is conveniently and substantially attached to the machine. It allows for access to the plate and blanket cylinders. Each sheet as it falls on the pile is gently jogged square.

The three sizes of the machines are:—No. 1, 52 × 37½ in., weighing approximately 6 tons 13 cwts.; No. 2, 45½ × 33½ in., 6 tons 2 cwts.; No. 4, 37 × 25 in., 4 tons.

The rotary offset machines occupy floor space of:—No. 1, 13 ft. 11 in. × 10 ft. 7 in., requiring a motor of 5 h.p.; No. 2, 13 ft. 0 in. × 9 ft. 10 in., motor 5 h.p.; No. 4, 10 ft. 3½ in. × 8 ft. 6½ in., motor 3 h.p.

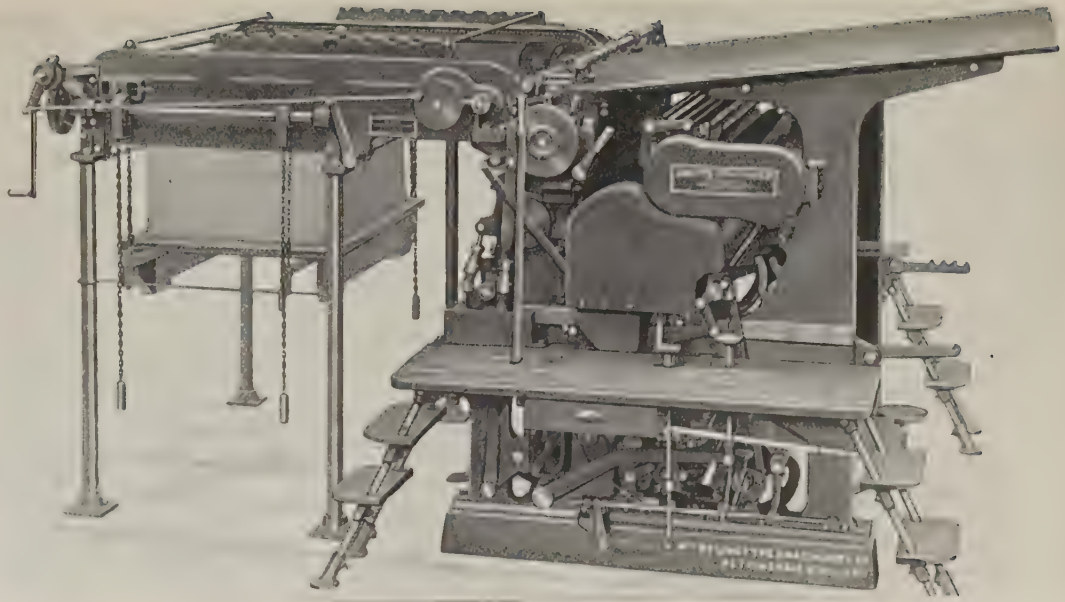
Amongst the details which these machines have, are a powerful attachment for securing a tight and even blanket, and a checking lever which throws all the working parts out of contact simultaneously. The impression cylinder has a smoothing brush so necessary for new and wavy paper. The machines may be fitted with automatic feeders, and the speeds attainable are from 2,500 per hour on No. 1 machine to 4,000 per hour on No. 4 machine.

The direct lithographic rotary machine was made quite early in the present century, and by 1910 had reached a high standard of efficiency. Since then every improvement in feed, inking, damping, delivery and check actions which have been applied to the rotary offset have been repeated on the direct rotary. Automatic feeders can be attached.

Both the L. & M. Offset and their Direct Litho Rotary, which have been installed in many of the well-known printing houses, are made in England at the works of Linotype and Machinery, Ltd., in Cheshire.

THE L. AND M. DIRECT ROTARY MACHINE.

Among the leading features of this press is the accessibility of the plate, and the facility with which it can be put on and removed.



Single-Colour Rotary Offset Machine. Linotype & Machinery, Ltd.

It is fitted with a backing-up motion controlled by foot levers, one at the plate cylinder end and the other in the foot board at the feed side of the press.

The water and ink supplies can be checked independently, and they are automatically checked when the cylinder is tripped, thus preventing excess of water and ink on the plate. The inking rollers are also raised from the plate at the same time, and can be raised or lowered by hand when required. The damping apparatus can be easily dropped from the plate, giving free access to the damping rollers.

The amount of vibration of the ink drum and the vibrator rollers can be varied between the maximum vibration and zero.

Special facilities are provided for access to inking and transfer rollers. Two transfer rollers are provided, the advantages of which are two-fold:—They give a better distribution of ink (a distinct advantage in heavy work), and enable the rollers to be arranged in two groups. This arrangement corrects the effects of any temporary excess of water which may occur, as the excess is entirely taken up by the first group, leaving the second group quite fresh to deposit the ink.

The ink fountain is freely accessible to the pressman for cleaning, filling, and regulating, and does not cause an obstruction when a plate is being put on the machine. The larger sizes of this press, Nos. 0 and 1, are fitted with a continuous ink-feeding device in addition to the usual ratchet ink feed.

An impression cylinder sheet brush is fitted and is adjustable for different sizes of sheet. This brush keeps the paper clean.

The delivery table is sufficiently high to enable pressman without inconvenience to examine the work and remove sheets.

Fly delivery is provided on Nos. 0 and 1; carriage delivery on Nos. 2 and 3. Both styles of delivery deposit the sheet printed side up.

It is built in four sizes, as follows, with sizes of paper taken: No. 0, 64 × 47 in.; No. 1, 64 × 44 in.; No. 2, 48 × 35 in.; No. 3, 42 × 32 in.

Size of machine, No. 1, paper size 64 × 47 in.; length, 7 ft. 11 in.; width, 6 ft. 11¼ in.; weight, 9 tons; maximum speed 2,000; motor, 5 h.p. No. 3, paper size 42 × 32 in.; length, 5 ft. 7 in.; width, 5 ft. 1¼ in.; weight, 5½ tons; maximum speed, 2,000; motor, 4 h.p.

Both the L. & M. Offsets, which have been installed in many well-known printing establishments, and the L. &. M. Direct Litho Rotary machines are made at the works of the Linotype & Machinery, Ltd., Cheshire, England.

JOHN RATCLIFF AND SONS, LTD., FLAT-BED OFFSET, DIRECT AND ROTARY OFFSET MACHINES.

FLAT-BED OFFSET MACHINE.

This firm was the first to make this form of machine, and it is only natural to expect that with their experience and progressive characteristics that this machine is as efficient as it can be expected. There is little doubt as to its utility when over two hundred of them have been sold in this country, to over seventy-five well-known firms, and to two Government Ordnance Offices.

It is averred that for runs up to 10,000 it is as good as rotary offset machines, if not actually more useful.

The machine is a properly built offset machine, and not just an attachment to a flat-bed machine to convert it. It may be added that the firm does also convert flat-bed machines for offset printing.

The flat-bed offset machines are built for crown, demy, double crown, double demy, and quad crown; and the particulars of two sizes are as follows:—

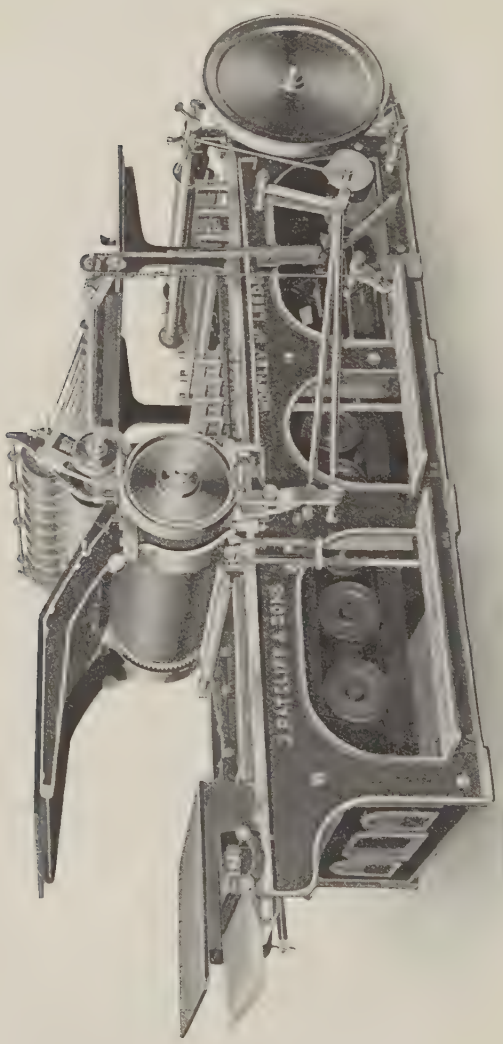
Crown: speed, 1,400; space occupied, 10 ft. × 5 ft. 2 in.; weight, $4\frac{1}{4}$ tons; gas engine, $\frac{1}{2}$ h.p.; motor, 1 h.p. Quad crown: speed, 1,000; space occupied, 18 ft. 2 in. × 7 ft. 11 in.; weight, 10 tons; gas engine, 3 h.p.; motor, 4 h.p.

There are eight inkers to the four large sizes, and six to the crown machine.

This firm has for many years made the "Reliable" flat-bed machine, for printing direct from stones or plates. It need scarcely be added that these machines are to be found in most British lithographic printing works, as well as in all parts of the world.

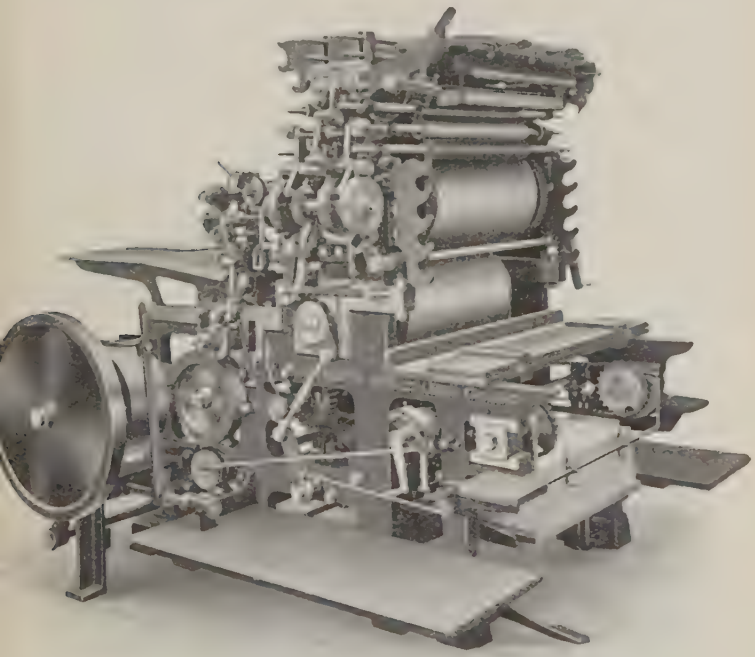
SINGLE-COLOUR ROTARY OFFSET MACHINE.

It will be remembered that in the early days of rotary machines, Messrs. Ratcliff made a good type of such machine, and as soon as offset rotary machines were a proved success this



Double Demy Flat-Bed Offset Machine. J. Ratcliff & Sons, Ltd.

firm turned its attention to that form of machine, with the result that their machine of to-day embodies the crucial points and engineering efficiency set up by the users as the standard of construction.



Demy Rotary Offset Machine. J. Ratcliff & Sons, Ltd.

The general build of the machine is on the disposal of the three equal cylinders on the "L" design—a form adopted by the majority of British and foreign makers, because of its compactness and accessibility.

The plate cylinder carries the ink slab as well as the plate. The latter is clamped at both the front and back edges, the clamps open automatically to receive the plate when the screws are released. Similarly the plate is released by a turn of the screws, when it has to be removed.

The transfer cylinder has two blankets. The under one is clamped at one edge and left loose at the other. The top blanket is stretched by two ratchet rods, one at the gripper edge and the other at the back edge. This facilitates building up to correct size when necessary and ensures a uniform thickness of blanket.

The impression cylinder being the same size as the other two cylinders, allows half its periphery for the impression surface and half for feeding the sheet to the feed gauges.

The damping mechanism is fitted well up above the feed board. The supply of water through the trough or duct roller can be regulated by a ratchet motion to any degree. The dwell of the feed roller on the trough roller can be regulated by a micrometer screw moving a special cam lever actuating the feed roller along a tapered cam. The damping rollers can be moved from the plate by a short movement of a handle. By giving a longer movement of the handle the rollers are moved so far away as to be easily accessible for removal. The damping rollers are automatically lifted each time the ink slab passes.

The trip is actuated by a pedal, and moves the transfer cylinder out of contact from the plate and impression cylinders. At the same time the inkers are lifted from the plate, the ink duct and the damping apparatus are both checked. The actual trip only takes place just before the impression cylinder takes a sheet, in this way the operator can trip at the last moment and save the sheet at the lays.

The feeding is from a stationary feed board, which is quite clear of the other mechanism, and allows room for any automatic feeder. Any make of automatic feeder can be attached.

The speed of feeding is only limited by the hand or automatic feeding capacity. The finest adjustments of the front lays and side gauges are effected by micrometer screws, to secure perfect register.

The delivery is effected by chain conveyors, and the sheets are delivered printed side up on a table at the back of the

machine under the blanket cylinder, projecting far enough for easy inspection. Over the delivery table is a platform for inspecting the inking apparatus, etc., which is usually kept hinged back. The pile delivery can be readily fitted when required.

The inking is effected by a system which is designed to give the maximum result. The ink is taken by the feed roller from the duct to a small polished steel drum, which is geared and reciprocated under a distributing roller. From this drum the ink is conveyed by two distributing rollers to a large steel drum, also geared and reciprocated. At each side of this drum are two rollers to convey the ink to two steel, geared, reciprocating distributing rollers which are in contact with the plate inking rollers.

The inkers are adjustable to the plate by set screws and hinged roller brackets. They are tripped by the pedal, already mentioned, and can be also tripped by a hand lever when the machine is either running or at rest. The ink duct and its accessories can be regulated to give any desired supply of ink. The ink slab on the cylinder affords the opportunity for the recovery of the rollers from the water on the plate.

The impression, or pressure, is effected by independent impression screws, so that the eccentrics when properly set need not be altered.

For various adjustments and fitting of plates and blankets the machine may be driven at slow speed by use of a pedal at the delivery end, or on the feeder's platform.

This single-colour offset rotary machine is made in the following sizes, etc.:—

Demy folio: paper, 20½ · 12½ in.; floor space, 5 ft. 4 in. × 4 ft. 4 in.; height, 4 ft. 9 in.; net weight, 2 tons; motor, 1 h.p. Quad demy: paper, 48½ · 36½ in.; floor space, 11 ft. 6 in. · 9 ft. 10 in.; height 7 ft. 7 in.; net weight, 7 tons; motor, 4 h.p.

ROTARY TINPLATE MACHINE.

This machine is built on similar lines to the single-colour offset rotary described above, but having a modified arrangement of the cylinders to suit the feeding and delivery of tinplate sheets instead of paper.

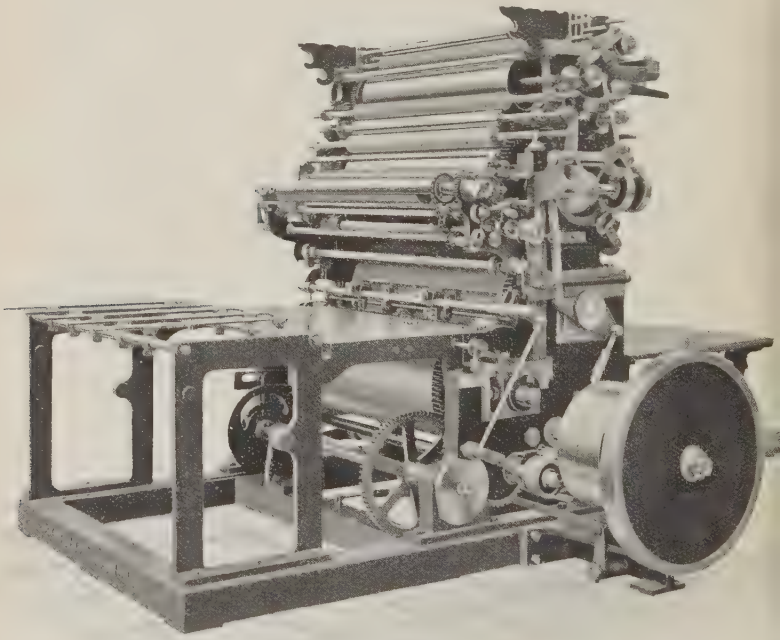
The tin sheets are placed directly from the racks, or from a pile, one at a time on to a receiving table composed of adjustable steel rods and from there taken by the feeder on to

a steel sheet feed table and fed into the gauges, which do not move until the grippers have closed.

The sheets are delivered on to travelling bands, which are extended as required to allow ample time for taking off for racking for the drying ovens.

The machine has been installed by most of the largest tinplate printers in Great Britain.

It is made in one size to take printing plates 37 · 30½ in., and occupying 10 ft. 5 in. · 8 ft. 4 in., with a height of 7 ft. 0 in. It it built to print 2,000 impressions per hour, with a motor of 3 h.p.



Tinplate Rotary Machine. J. Ratcliff & Sons, Ltd.

The "Reliable" tinplate flat-bed machine is built on the same lines as the "Reliable" paper printing machine. They are as strong as possible in construction, with double gear throughout, to resist vibration, and secure good register. The rolling power is ample and double rolling is seldom necessary. The delivery is directly upon travelling belts, which convey the plates to the end of the machine where it is easy to rack them at once; but a tray may also be fitted to receive the plates. The check or trip stops the ink supply from the duct, simultaneously with stopping the printing cylinders. This machine is built to give a run of 4,500 to 6,000 per day. It is made in all sizes from demy to quad crown. Machines of this type are installed in some of the largest tin-printing works, and as many as twenty are in one works.

THE "WAITE" ROTARY OFFSET MACHINES FOR ONE AND TWO COLOURS (WAITE AND SAVILLE, LTD.)

It may be well remembered that in the early days of rotary offset machines that one of the noticeable difficulties to the machine makers was to avoid the appearance of "gear marks" on the prints. This firm adopted a different form of drive, which proved highly successful. The cylinders are driven by generated helical gears, which ensure the cylinder running in perfect unison throughout the life of the press. In addition the whole of the inking mechanism is driven direct from the driving shaft. These two features make the "Waite" machines stand somewhat apart from most other models. The general construction of

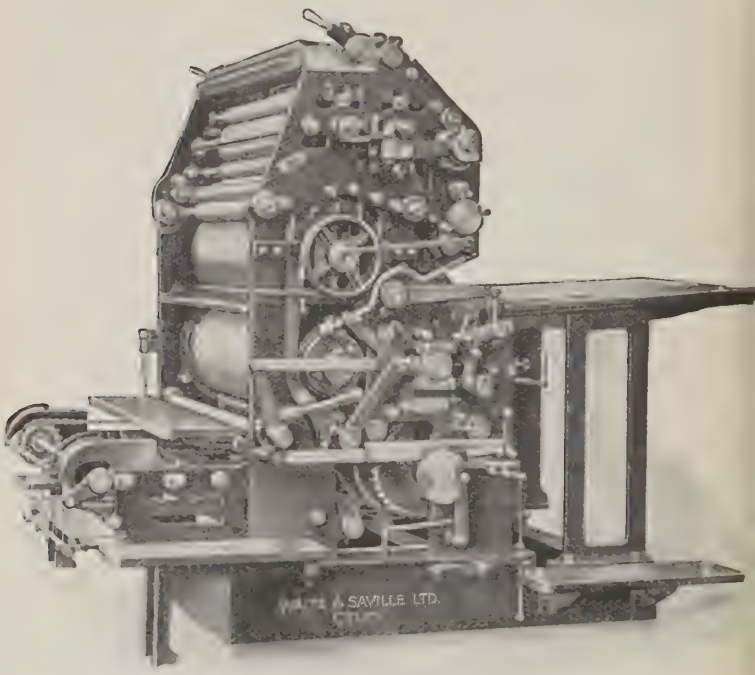
THE "WAITE" ONE-COLOUR MACHINE

is rather similar to the American models. The inking apparatus is at the top of the vertical frame, bearing directly down upon the plate cylinder, and the damping apparatus projects over the feed board. The dampers themselves work laterally against the plate cylinder.

The blanket (or transfer) cylinder is vertically below the plate cylinder and makes contact with the impression (or gripper) cylinder at an angle of about 100° from the vertical line. By placing the impression cylinder so far up against the blanket cylinder it reduces the height of the machine, and

adds compactness to its appearance. Also, this reduction in height makes the inking apparatus, plate cylinder and blanket cylinder more accessible.

The feed may be by hand or automatic feeder, working directly to the top of the impression cylinder, and the printed



Double Medium Rotary Offset Machine.
Waite & Saville, Ltd.

sheet is taken away from underneath the cylinder to a board, or to a pile delivery. The latter places the impression at a suitable height for inspection.

The three cylinders are of equal diameter, and, therefore, the machine gives an impression at each revolution.

Dimensions of the one-colour offset:—Royal folio: length, 4 ft. 9 in.; width, 5 ft. $1\frac{1}{2}$ in.; height, 5 ft. $2\frac{1}{4}$ in.; speed, 4,000; motor, 1 h.p. Double crown: length, 6 ft. $9\frac{3}{4}$ in.; width, 5 ft. $7\frac{1}{2}$ in.; height, 5 ft. 11 in.; speed, 3,800; motor, $2\frac{1}{2}$ h.p. Quad crown, length, 10 ft. $5\frac{1}{2}$ in.; width, 7 ft. $5\frac{1}{4}$ in.; height, 7 ft. $5\frac{1}{4}$ in.; speed, 3,200; motor, 5 h.p.

It is also made for medium, royal, double medium, quad demy and eight-crown. The eight-crown has a length of 12 ft. 2 in.; width, 9 ft. 11 in.; height, 7 ft. $6\frac{1}{2}$ in.; with speed of 2,800, and requiring 6 h.p.

THE TWO-COLOUR "WAITE" ROTARY OFFSET MACHINE,

for quad crown, is 15 ft. 9 in. long, 9 ft. 5 in. wide, 8 ft. 9 in. high. To accommodate the extra cylinders required the arrangement of the cylinders as in the one-colour machine is mounted about one-cylinder's diameter, in the vertical frame, to allow the second blanket cylinder to work in contact with the impression cylinder, and receive its print from the plate cylinder which is mounted under the feed board and almost parallel with the blanket cylinder.

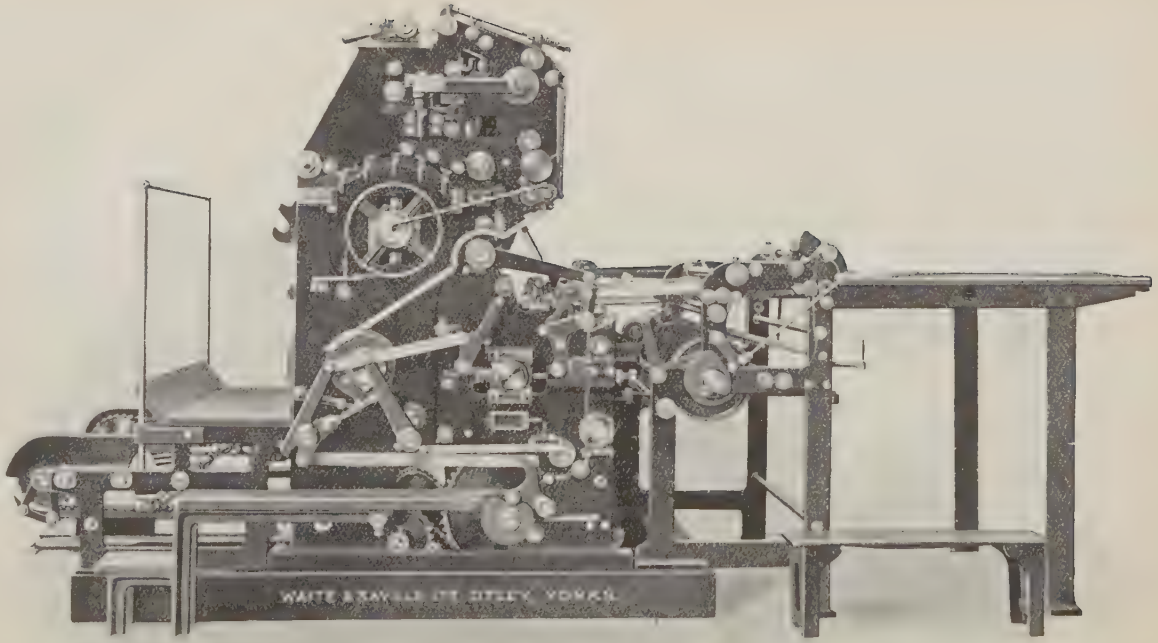
The two printing units—the plate and blanket cylinders—are thus quite separate, leaving convenient spaces for access to the inking and damping apparatus.

The two-colour machine produces a two-colour print the same time as the single-colour machine produces its one print.

The other important alteration made is that the delivery grippers take the sheet from near the top of the impression cylinder, and over the feed board to the pile, at the far side of the gap used for the feed and inspection of the second plate cylinder, inking and damping apparatus.

This firm makes the "Waite" automatic feeder, also the "Waite" semi-automatic feeder. The latter enables the sheet to be fed by hand to an approximately correct position, then it is carried forward to the machine gauges, where it is automatically registered, thereby eliminating the possible inaccuracies of hand feeding.

In all other details these machines are made on the same progressive lines as most other machines. The inking with oscillating drums and riders, the fine adjustments of inking

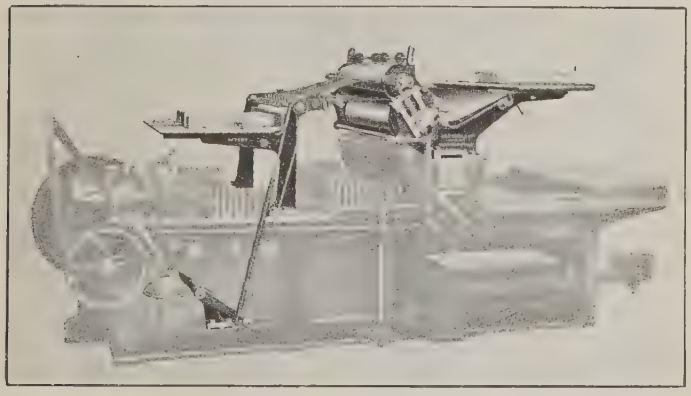


Quad-Demy Rotary Offset Machine, with Waite Semi-Automatic Feeder,
Waite & Saville, Ltd.

and damping with oscillating brass roller, the adjustment of pressure, the clamping of the plate, the tightening of the blanket, and the universal trip, being all of the same accuracy and fineness as expected on this type of machine.

J. AND S. EYRES, LTD.

For the last fourteen or fifteen years, this firm has made a complete attachment to fit upon flat-bed lithographic machines to convert them into offset machines. This attachment has already been working satisfactorily on over 300 machines.



ATTACHMENT TO FLAT-BED LITHOGRAPHIC MACHINES TO CONVERT INTO OFFSET MACHINES.
J. & S. EYRES, LTD.

It is obvious that any printer who has good flat-bed machines would find the benefit of such an attachment. It can easily be thrown out of gear and the machine can be used for direct work. Such a change being effected in about fifteen minutes.

Many printers recognize that metal plates can be readily mounted on flat-bed machines, and that it is easy to put in any underlays on a bed plate.

As so much work is only in short runs, a flat-bed offset machine with its ease of adjustments of plates, inking and damping, is highly suitable; and at the same time it is equally evident that for long runs the rotary offset machine has undeniable advantages, more especially for large work.

A special feature of having this attachment on a flat-bed machine is that it can be used for proving offset work, either by hand rolling or under proper machine rolling. The latter is the correct way, as it is not likely to give a false idea as to how the complete issue will appear.

The attachment can be made in any size to suit existing flat-bed machines of any make.

If required, automatic feeding and pile delivery may be fitted; although it is not considered advisable to have these additions unless there are many regular runs of 5,000 and over.

The attachment is made at the engineering works in Miles Platting, Manchester.

MARINONI-VOIRIN ROTARY OFFSET MACHINES FOR ONE, TWO, AND THREE COLOURS, AND PERFECTING.

It was this firm which in 1884, by Patent No. 12,010, under the names of Marinoni and Michaud, constructed the first offset machine. (See diagram on page 219). This early invention was elaborated in 1886, by their engineer, Michaud, in the construction of a perfecting offset machine.

When rotary offset machines were first made in France they were the products of the two well-known printers' engineers, Messrs. Marinoni and Messrs. Voirin. More recently these two firms have been combined and the products are French-made machines of high efficiency.

These machines are made in the following models:— Two-colour, high speed, single blanket, superimposed; two-colour, two blankets, which also perfects; two-colour, two-sheet printing on one side only; three-colour, three-sheet printing on one side only; perfecting, either reel or sheet fed, single colour, from medium sheet to 65 × 47 in. (special model of which is the "Monobloc," which is purely automatic).

Their single-colour machines are on the conventional lines followed by the principal makers throughout the world, i.e., small cylinders of uniform diameter, one revolution giving

one impression, but in detail they incorporate many of their special and original features.

Although these machines have a resemblance to the American models, they are not in any way restricted to the arrangements of any previous makes. In fact, each machine is built on its type for its own purpose.

TWO-COLOUR SUPERIMPOSED ROTARY OFFSET MACHINE.

Within the strong iron framework are the four cylinders of equal diameter to produce a complete two-colour print at each revolution. The principle involved is different from other well-known machines. There are two plate cylinders—one vertically over the blanket cylinder and the other placed

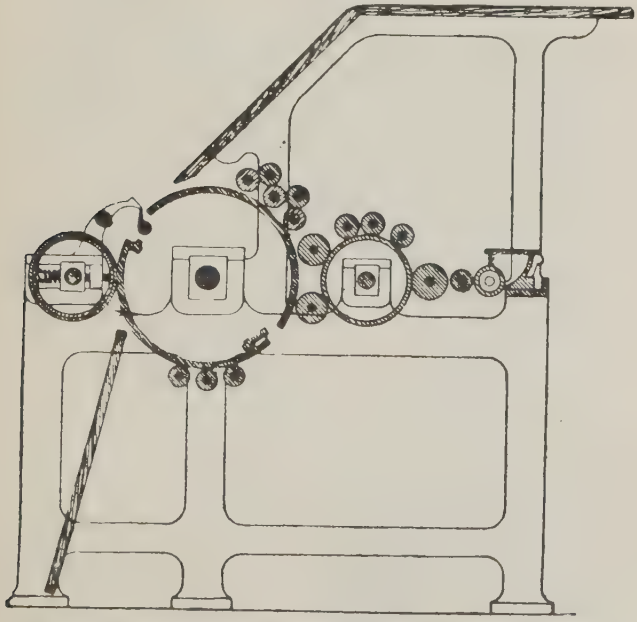


DIAGRAM OF THE FIRST OFFSET MACHINE, PATENTED IN 1884 BY MARINONI.

beside that cylinder—which almost simultaneously print the two colours on the blanket cylinder in register. The impression cylinder takes the two colours at once from the single blanket.

Each plate cylinder has its full complement of inking and damping apparatus, which have fine adjustments for regulating the supply, to a most minute degree. The plate cylinders have circumferential and lateral adjustments for register.

The paper is fed to the top of the impression cylinder by hand or by the firm's own pile suction automatic feeder. The lays and stops are ingeniously made to avoid any error in the feed, especially for register work. The printed sheets are taken from the lower surface of the impression cylinder to a board underneath, which projects at the back of the machine, or to a pile delivery. The sheets are delivered printed side up on the delivery board, which is provided with a jogger, to give a neat pile.

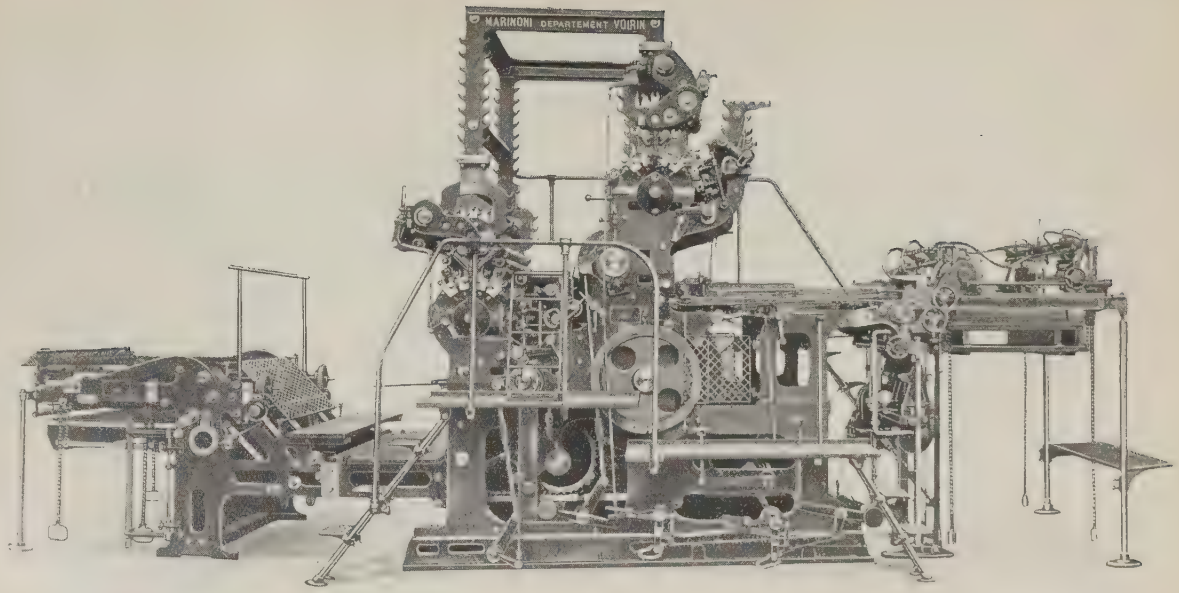
The drive of the cylinders is by "helical" gear to avoid gear marks. This type of gear is on all the machines made by this firm.

The dampers are mounted on two levers, one at each end, which are actuated by springs. In this way the dampers adapt themselves to the plate and imitate hand damping. The damping roller stocks and water distributing drum are covered with an electric deposition of zinc, to avoid rust.

The inking apparatus is arranged to work over the tops of the plate cylinders. The skins used are very carefully selected; the rollers are finished in a machine to secure evenness, and they are broken in ready for immediate use. "Ideal" rollers are fitted when required.

The foregoing particulars of the special features of this machine may be taken as applying to all the other models.

Particulars of the two-colour rotary offset:—Paper, $31\frac{1}{2} \times 41\frac{1}{2}$ in.; floor space, 12 ft. × 9 ft. 6 in.; height, 8 ft. 9 in.; motor, $5\frac{1}{2}$ h.p.; impressions per hour by automatic feeding, 3,500. Paper, $35\frac{1}{2} \times 49\frac{1}{4}$ in.; floor space, 12 ft. × 9 ft. 10 in.; height, 8 ft. 9 in.; motor, 6 h.p.; impressions per hour by automatic feeding, 3,000. Paper, $39\frac{1}{4} \times 57$ in.; floor space, 13 ft. 6 in. × 10 ft. 3 in.; height, 9 ft. 3 in.; motor, 7 h.p.; impressions per hour by automatic feeding. 2,500. Paper, $47\frac{1}{4} \times 65$ in.; floor space, 15 ft. × 11 ft.; height, 10 ft.; motor, 8 h.p.; impressions per hour by automatic feeding, 2,000.



MARINONI-VOIRIN TWO-COLOUR TWO-SHEET ROTARY OFFSET MACHINE. FRANCIS J. CONNOLLY, LTD.

TWO-COLOUR OR PERFECTING, TWO-BLANKET ROTARY OFFSET MACHINE.

This model assimilates to some British machines in its main principles. There are three cylinders of equal diameter and the impression cylinder of half their diameter which makes two revolutions to complete the print. The four cylinders are in the same positions as those in the two-colour machine just described, but the smaller size of the impression cylinder allows more space below for delivery.

The two plate cylinders are severally complete units, and they imprint their colours on two blankets on the blanket cylinder, from which the impression cylinder takes one colour by one revolution and the other colour by its second revolution. In all other respects the machines are the same.

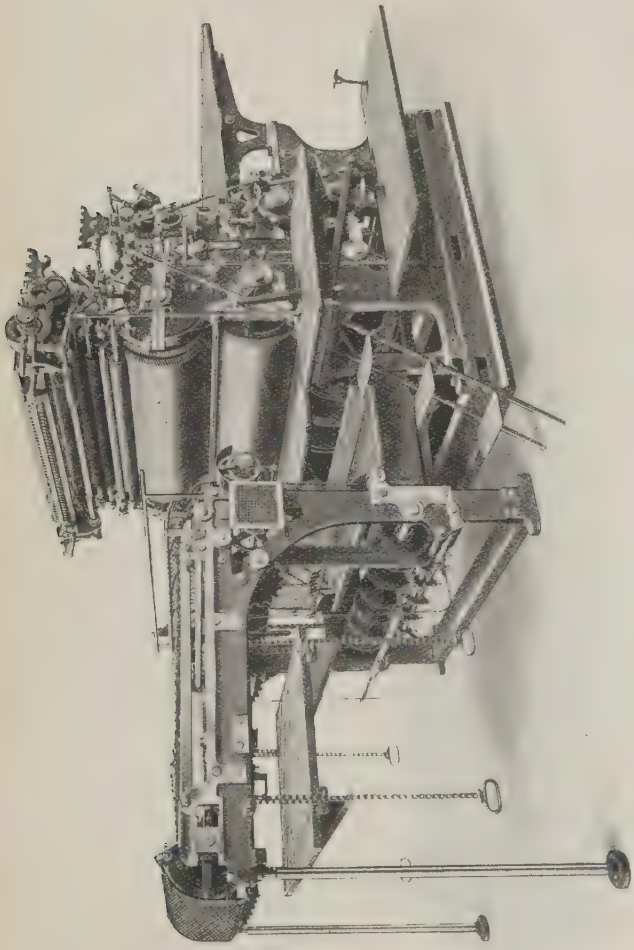
The perfecting operation requires that the top printing plate must have the subject matter on it in the reverse, or as on the stone in direct printing machines. By "timing" the grippers, the top plate is printed on a blanket on the impression cylinder at its first revolution. At its second revolution the paper is taken and receives the impression on its underside at the same time that the second blanket prints on the top side.

The dimensions of these machines are:—31½ × 41½ in.; floor space, 13 ft. 2 in. × 9 ft. 5 in.; height, 9 ft.; motor, 6 h.p. 35½ × 49¼ in.; floor space, 13 ft. 2 in. × 10 ft. 1 in.; height, 9 ft.; motor 7 h.p.; impressions per hour with automatic feeding, 2,500. 39¼ × 57 in.; floor space, 14 ft. × 11 ft.; height, 10 ft. 3 in.; motor, 8 h.p. 47¼ × 65 in.; floor space, 15 ft. × 11 ft. 3 in.; height, 11 ft.; motor, 10 h.p. Being rather larger they require more power than the two-colour superimposed offset machine.

The change from printing two colours on one side, to one colour on each side, occupies but a few moments.

THE PERFECTING ROTARY OFFSET MACHINE.

This machine presents another phase in structure. The printing is carried out by four cylinders of equal diameter—two for plates and two for blankets—no extra impression cylinder being needed, because the paper is fed to grippers on a blanket cylinder, and the pressure for printing is exerted by the two blanket cylinders when they print both sides of the paper at once. This machine is made with a paper roll reel and a cutter, and the cut sheets are carried on tapes to



Single-Colour Rotary Offset Machine with Pile Delivery.
Francis J. Connolly, Ltd.

the feeder. When necessary it is made with the pile suction feeder for cut sheets. It is made in the three largest sizes in the above, and is from 3 ft. to 6 ft. longer, scarcely any wider, and not so high as the two-colour successive offset. The motor h.p. is less than for that machine.

One of the plate cylinders is inked from below, that is the method known as "inverted inking."

This machine may be used for either perfecting or printing on one side only in one colour. It will not print two colours on one side. According to the printing cylinder selected the printed sheets may be delivered either face up or face down.

The work produced is in good register, and further printings may be added in perfect register. This model of machine obviates the use of a transfer cylinder for perfecting, and both printing plates have the designs in the positive or normal direction. The balance of colour is well maintained and the thinnest paper may be perfected in register.

This machine, in quad demy size, and automatically fed will print 3,000 impressions per hour.

THE SINGLE-COLOUR ROTARY OFFSET MACHINE.

This machine may be considered as the model for the other variations. It is a compact, upright machine, with the inking apparatus at the top, working directly down on the printing plate cylinder. This cylinder projects at the back of the machine, leaving space for the damping apparatus and a roller rack on the feed side. There are three cylinders of equal diameter, thus giving one impression for each revolution. The plate cylinder is in fixed bearings, so that when the inking rollers are set to their proper position no alteration need be made, the position being a permanent one.

The blanket and impression cylinders are in eccentric gunmetal bearings, to facilitate adjustment of pressure. In checking or tripping, only the blanket cylinder is moved out of contact with the other two cylinders, and at the same time the ink and water supplies are checked.

All the machines fitted with the pile suction feed are made so that the pile carrier can be wheeled to and fitted into the feed framework for successive printings.

The dimensions of this machine are:—Paper, 22 × 30 in.; length, 6 ft. 8½ in.; width, 6 ft. 8½ in.; height, 6 ft. 7 in.;

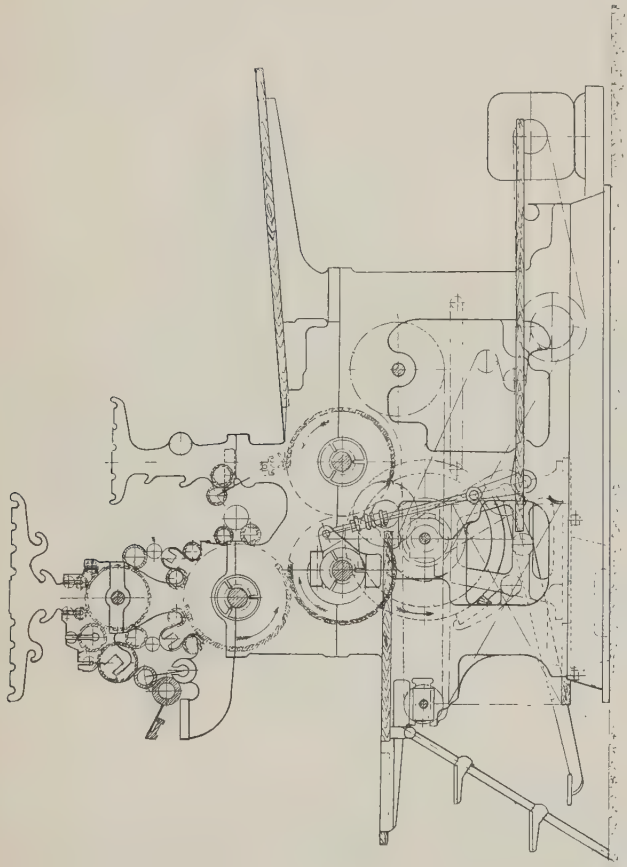
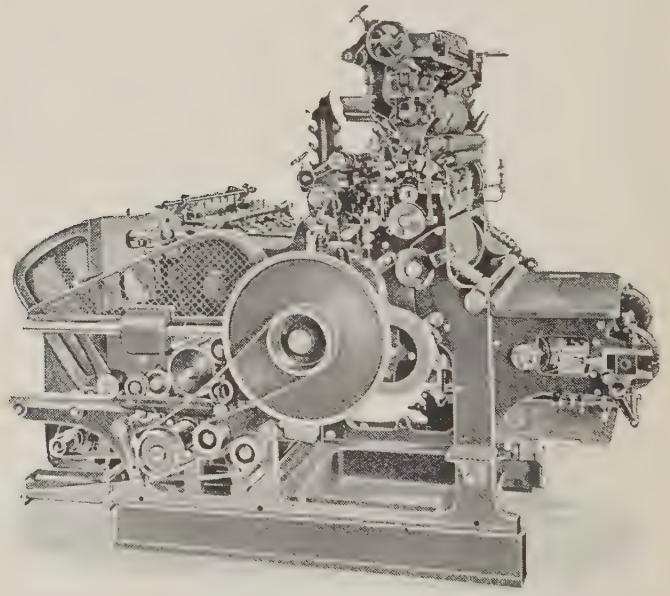


Diagram of Marinoni-Voirin High-Speed Single-Colour Rotary Offset Machine.
Francis J. Connolly, Ltd.

motor, 2 h.p.; and in six sizes up to 47½ × 65 in.; length, 14 ft. 7 in.; width, 11 ft. 8 in.; height, 9 ft. 6 in.; motor, 5 h.p.; impressions per hour, automatic feeding, quad demy, 3,000.



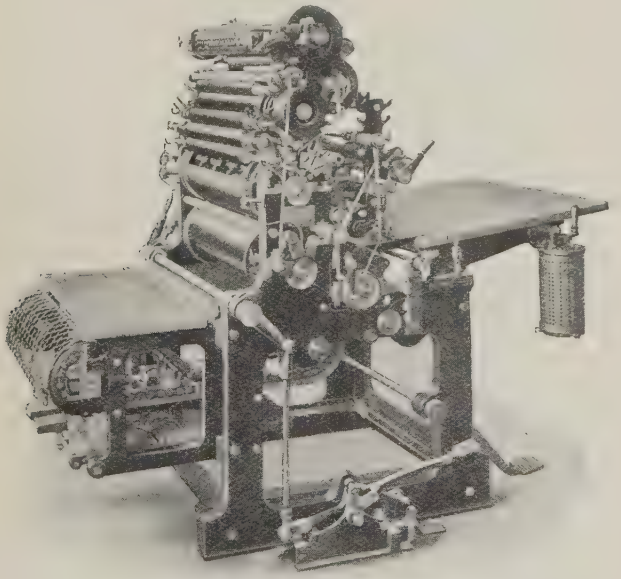
"Monobloc" Single-Colour Rotary Offset Machine, Drive Side.
Francis J. Connolly, Ltd.

THE "BIJOU" SINGLE-COLOUR ROTARY OFFSET MACHINE.

For printing paper 18½ × 23½ in. at a high speed, this machine has been constructed on the model of the single-colour offset, with every attention to its details that makes for ease of running and large output. It may be fed by hand up to 3,000 per hour, or automatic pile suction feeder at a speed of 4,000 per hour for register work. This latter is known as the "Monobloc."

The dimensions are:—Paper, $18\frac{1}{2} \times 23\frac{1}{2}$ in.; length, 6 ft. 6 in.; breadth, 4 ft. 9 in.; height, 5 ft. 5 in.; motor, 1 h.p.

It appears that this firm has in construction a new model of the single-colour machine, in which the position of the cylinders is slightly altered; and will be more rigid than the present type, and run at higher speed.



No. 1. "Bijou" Single-Colour Rotary Offset Machine. Francis J. Connolly, Ltd.

THREE-COLOUR SUCCESSIVE ROTARY OFFSET MACHINE (*Patented*).

For three successive colour printings this machine is rather larger than the perfecter for the same size of paper. The one size made is for paper $35\frac{1}{2} \times 49\frac{1}{4}$ in., and its dimensions are:—Length, 15 ft.; breadth, 10 ft.; height, 9 ft. 6 in.;

weight, 25 tons, and requiring 12 h.p. motor. It is three single-colour machines combined to work on to one impression cylinder with a circumference equal to the three blanket cylinders combined. The three plate cylinders are inked at the top.

The delivery pile is under the feed board, but the pile of printed matter may rise nearly three feet.

It will be seen that the impression cylinder being three times as large as the others, it is possible to have three sets of grippers at one-third intervals, and carry three sheets of paper. The first revolution of the impression cylinder produces the first print in three colours, and at every successive third of a revolution another print is delivered.

In all the foregoing machines the construction is made more rigid by having the vertical frames rebated into the solid base plates, and then bolted down, instead of being bolted only.

Many of the various machines have been installed in different parts of the world, and one of the single-colour model has been placed in the London School of Printing.

THE HARRIS OFFSET ROTARIES.

THE LANSTON MONOTYPE CORPORATION, LTD.

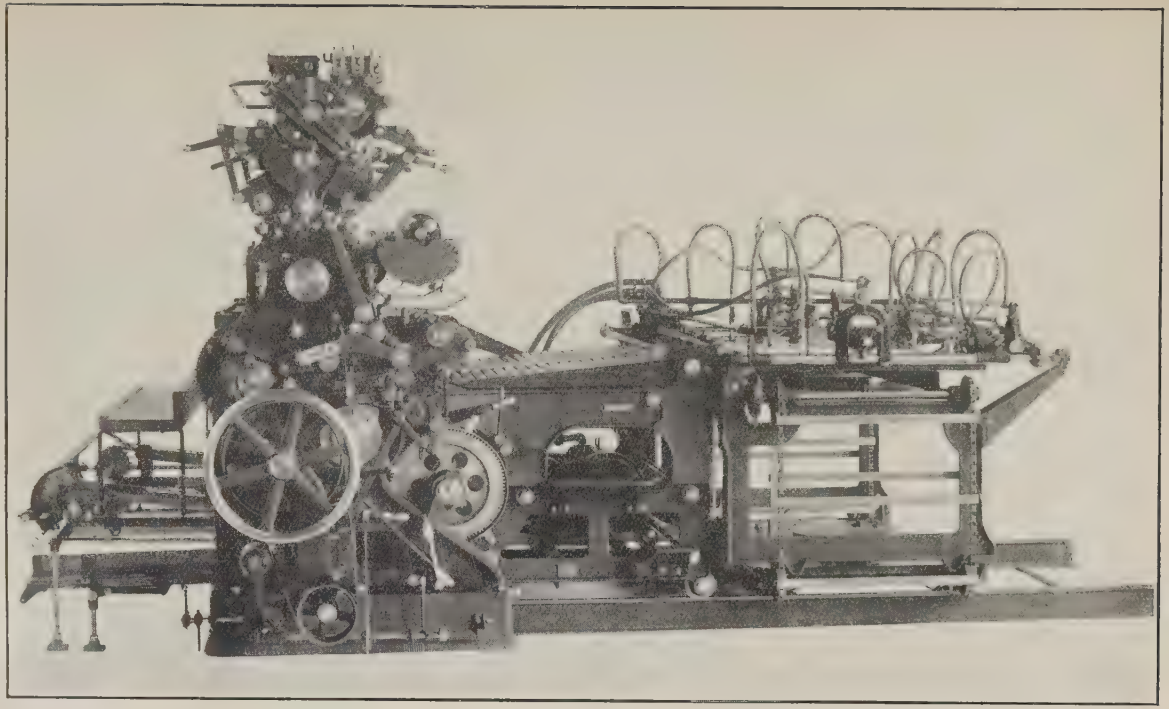
[In America there is a combine of Harris-Seybould-Premier-Potter.]

The Harris model of rotary offset machines has been known since the commencement of offset printing proper in 1907–8. It is probably the most widely known, and the number of machines installed all over the world must be the largest of any one firm's pattern. It is stated by the makers that there are as many if not more of their offset machines than all other firms added together.

In the earlier years of offset the Harris machines showed such a high speed, especially with the mechanical feeder, upon medium size work, that they gained considerable popularity.

The machines made are:—Single-colour rotary offset, seven sizes from 24 × 36 in. up to 64 × 44 in. Two-colour rotary offset, three sizes—No. 45 for paper 64 × 44 in.; No. 34 for 22 × 17 in. to 48 × 36 in., also No. 41, 38 × 52 in.

The No. 45 is built in two patterns, viz., one for paper up to .022 in. thickness, another for cardboard .015 in. to .040 in. thickness.



HARRIS OFFSET PRESS. LANSTON MONOTYPE CORPORATION, LTD.

The general build of these machines, which is recognized as the American model, is that the three cylinders are mounted one above the other in a vertical framework. The inking apparatus is at the top, bearing on the plate cylinder; the damping apparatus works horizontally on the plate, and projects somewhat over the feed board; the impression is the lowest, and the paper is fed to the top of it, being delivered at the back of the board partly under the impression cylinder. This disposal of the parts is much the same whether the machine is fed by hand or by automatic feeder.

The smallest machine, No. 31, will take paper from 14 × 17 in. up to 24 × 36 in., and can be run by an automatic feeder at about 6,000 per hour. The Harris suction pile feeder may also be fitted. The motor required should be 5 h.p.

The one-colour rotary offset machine, No. 34, is designed for highest grade colour work and may be run as high as 3,500 per hour for accurate register, upon sizes of paper from 14 × 17 in. up to 48 × 36 in. The Harris suction pile feeder is an integral part of the machine, and is suitable for the pile delivery. The driving motor should be 7½ h.p.

TWO-COLOUR ROTARY OFFSET MACHINE.
Nos. 45 and 34.

These machines are practically made up of two single-colour machines brought into joint production by a positive transfer cylinder.

The suction pile feeder is largely dependent upon air-blast and suction. The air blast separates the sheets, whilst combing wheels at the back of the pile raise the corners of the sheet and rubber suckers lift the sheet, allowing presser feet to bear upon the pile and supply a blast which helps to float the sheet. The front suckers pick up the sheet and carry it to a 3 in. diameter taking roll, which starts the sheet down the roller table to the register lays and impression cylinder. This feeder is built as an integral part of the machine, and the pile of paper to be fed may be 40 in. high. When large sheets of paper or cardboard are to be fed, an additional cam has to be added, and the supply of air has to be increased to float the sheets forward. Larger pumps and air tank are supplied on the No. 34 model.

The feeder is loaded from the back only, and the plate which carries the pile is interchangeable with the delivery plates.

Plate cylinders. These are the same size as in the single-colour, No. 34 model, 16 in. diameter.

The printing plates are also interchangeable in these two machines; but in the No. 34 two-colour machine there is adjusting gear with screw adjustments for the plate around the cylinder. The plate cylinders may be moved laterally on their axle line one-sixteenth inch each way to secure register.

Blanket cylinders are the same in both the single and two-colour machines. The blankets are same size. The blanket has full length clamps on both edges, one of which fits into a fixed notch, the other into a reel rod. The blanket can be mounted on the cylinder in about five minutes.

The grippers on both the impression and transfer cylinders are each governed by a spring. Spring grippers on these machines have proved very satisfactory.

The transfer cylinder is adjusted by a micrometer screw to secure the absolute strike of the gear for the proper transference of the sheet from one colour to the other. This adjustment can be made while the machine is running.

The pile delivery also carries spring grippers.

The pressure in these two models of machines, Nos. 45 and 34, is effected by moving the eccentrics at both ends of the axle of the cylinder simultaneously by a connection from one side to the other, which can be adjusted to one-thousandth of an inch as indicated on a dial, by a micrometer screw. In changing from paper to cardboard up to .030 in. thickness there are only two settings necessary, as well as a screw adjustment for the delivery. All these adjustments are on the operating side of the machine.

The inkers may be on solid stocks when leather covered or hollow stocks for the "Ideal" or rubber covering. Each plate has four inkers, as in all the other models of the Harris machines. In the ink duct the roller revolves at the same face speed as the ink drum and deposits ink over a large area rather than in narrow strips as was the previous custom.

The damping water supply can be regulated to any degree. The brass vibrating water roll is gear driven, and there are the three damping rollers.

The details of these two models are in most cases, especially in the No. 34 single-colour machines, on the same lines, and no doubt in the near future most of the important improvements in the pressure, blanket and plate cylinders will be adopted on all the "Harris" machines.

The No. 34 two-colour machine will give 3,500 impressions in register per hour, with a motor of 10 h.p.

The No. 45 model will give 3,000 impressions, in register, with a motor of 15 h.p.

R. HOE AND CO., LTD.

ONE AND TWO-COLOUR ROTARY OFFSET MACHINES AND FOUR-COLOUR DIRECT ROTARY MACHINE.

This firm was one of the earliest to start the manufacture of direct rotary machines for printing from zinc and aluminium. Their patents of these machines date from 1870, and from 1899 many more patents were taken by them. Since then improvements have been made from year to year. The present machines made in New York are replete with all the latest devices as demanded by printers in modern times. Messrs. R. Hoe & Co. absorbed the Hall Co. in 1924, and now embody all their exclusive features in the latest machines.

In brief, the construction provides that: The ink rollers can be run up in ink without inking the plate. The plate can be inked without printing on the rubber blanket. The rubber blanket can be printed upon without offsetting on the bare impression cylinder. And it is not necessary to spoil the first or last sheet passing through the machine, when the impression is checked or tripped on or off.

The features of these machines which assist in the foregoing are:—

Inking by large diameter rollers to give greater contact surface between the rollers. The distributors, as well as the cylinders, are all positively driven. The inking rollers are mounted on swinging arms so arranged with the damping rollers that it is impossible for the inkers to make contact with the plate until the dampers are on the plate. All adjustments may be made from the floor level, and the ink duct has a removable back.

Damping. The contact of the dampers with the plate can be adjusted to any desired pressure, and the water supply can be regulated to any degree of fineness. The water duct roller is gear driven; the rider oscillates, and the duct is so arranged that the water can be run off.

Cylinders. The gears are centred on the cylinder hubs and bolted directly to the cylinder body. The gearing is furnished with backlash rims to prevent any play or slipping, and the gear on the cylinder is adjustable within a limited range to alter the lay of the design on the plate to secure register. The new sheet-detecting device makes it impossible to print upon the cylinder by tripping when there is not a sheet in the grippers.

The feed may be by hand or automatic feeder. The firm makes its own automatic suction feeder, which is built as an integral part of the machine. The sheets are delivered face up on a delivery board (with jogger) at the back under the cylinder, so that they are accessible for inspection at a point where the machine minder has all adjustments under his control.

The fine adjustments of damping, inking and register are indicated upon dials or bars to prevent errors of judgment, and to assist in quick starting.

There are two features in the details of all these machines which have been patented and require description.

The plate clamp on the cylinder consists of two parts. First, the clamp body which is pivoted in the cylinder, and second, the jaw which is pivoted to the body. The plate is placed in the jaw and held temporarily by the turn of a thumb screw. One centre bolt on each clamp tightens the plate in the jaw and at the same time draws the plate tight over the cylinder. The nipping edges of the clamp are smooth and should not damage the plate. To remove the plate it is only necessary to loosen the clamp at one edge, and the other edge is released automatically.

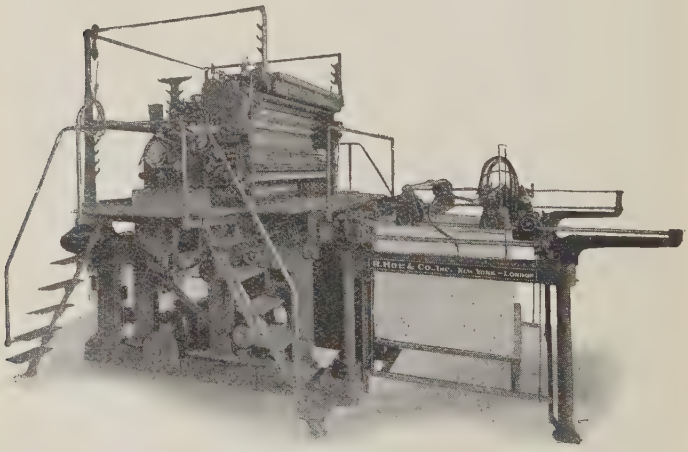
The feed. The sheets on being fed are carried vertically upward and partly over before reaching the impression cylinder, so that anything which may have fallen or been left on the sheet will drop off and down to the floor, thereby preventing accidents. The foregoing details, although applicable to the single-colour rotary offset machine, are in the main

the same as the other machines with the inevitable modifications that must be made for larger machines.

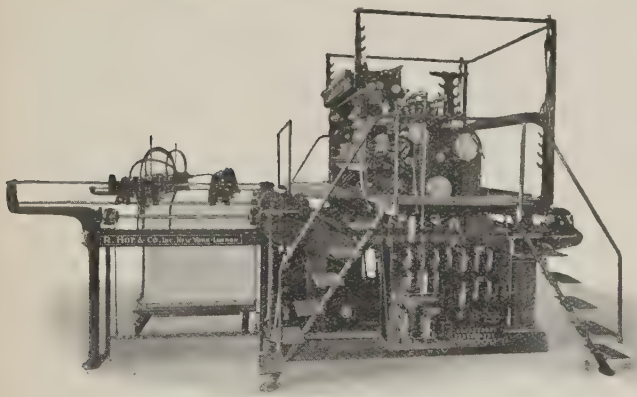
The one-colour rotary offset machine has the following dimensions:—Size of paper, 28 × 34 in.; length, 8 ft. 6 in.; width 7 ft. 10½ in.; height, 6 ft. 6 in.; motor 3 h.p. Size of paper, 30 × 40 in.; length, 8 ft. 6 in.; width, 8 ft. 6½ in.; height, 6 ft. 6 in.; motor 3 h.p.

ONE-COLOUR ROTARY OFFSET MACHINE WITH AUTOMATIC FEED AND DELIVERY.

This machine is larger than the ordinary one-colour machine, with the firm's own make of pile suction feeder and pile delivery, with trucks interchangeable. With this alteration the printed sheet is delivered at about four feet from the floor, printed side up. Machines of this type are built in different sizes, of which the popular size is for paper 41 × 54 in. The speed of this press is normally 3,400 impressions per hour, but may be run as high as 4,000 impressions per hour, and requires a 7½ h.p. motor.



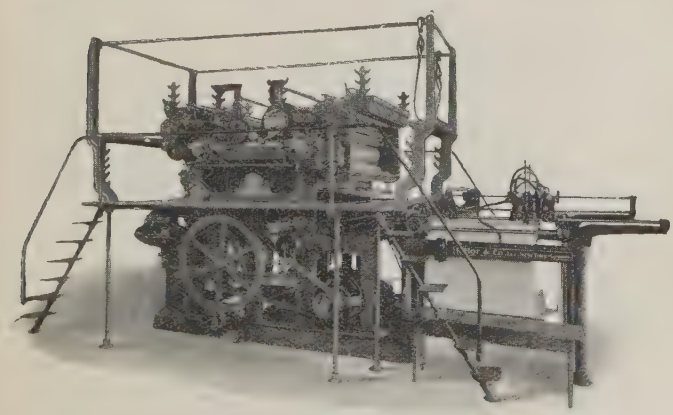
Single-Colour Rotary Offset.
R. Hoe & Co., Ltd.



SINGLE-COLOUR ROTARY OFFSET.
R. HOE & CO., LTD.

TWO-COLOUR ROTARY OFFSET MACHINE.

This machine is fitted with pile suction feed and pile delivery and is built in three sizes, 34 × 46 in., 41 × 54 in. and 46 × 66 in. The machine is in all respects of the improved



TWO-COLOUR ROTARY OFFSET.
R. HOE & CO., LTD.

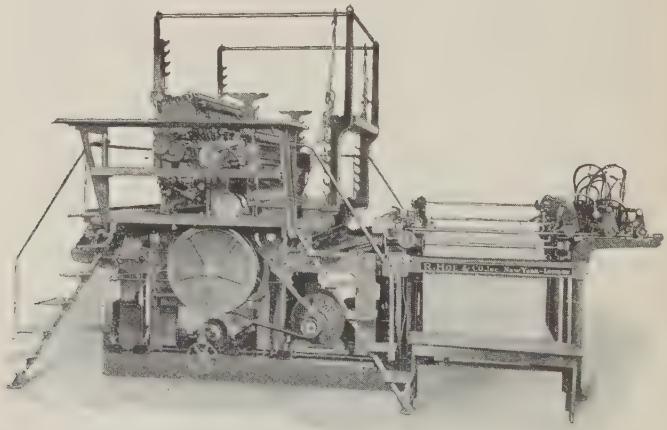
character already described, and machine taking sheet 41 × 54 in. will turn out the highest quality of work at 3,000 impressions per hour.

Arrangement of cylinders in this press is such that only a single surface impression cylinder is required to complete the printing of two colours, without the necessity of transferring sheet.

SINGLE-COLOUR DIRECT ROTARY MACHINE.

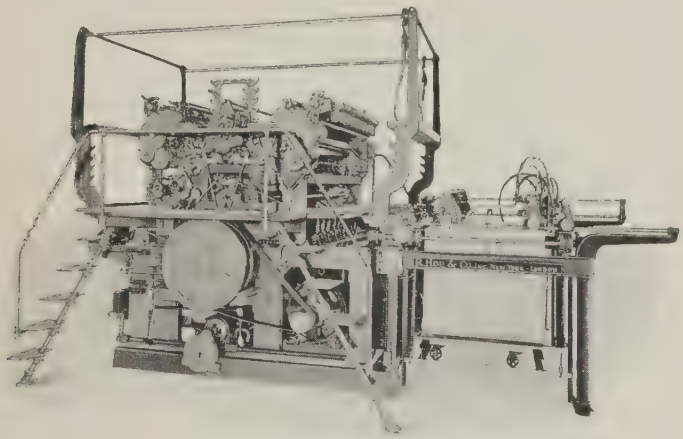
These machines are built in different models, such as hand-fed fly delivery, hand-fed chain delivery, automatic sheet stacking delivery, and in several sizes for paper 41 × 54 in. and 46 × 66 in. These machines are furnished with six forme rollers and sufficient oscillating rollers and ink drum to obtain the highest class of colour work, economically.

The operating speed of these presses, depending on size of paper and motor, is from 1,800 to 3,000 impressions per hour, and requires from 5 h.p. to 7½ h.p. motors.



SINGLE-COLOUR ROTARY DIRECT.
R. HOE & CO., LTD.

These machines are entirely automatic in their operation as regards to tripping of cylinders and ink, and have all of the features furnished on the offset presses that are essential for a high-class printing press.



Two-Colour Rotary Direct.
R. Hoe & Co., Ltd.

MULTI-COLOUR DIRECT ROTARY MACHINES.

These machines are built in several sizes for 41 × 54 in. and 46 × 66 in. paper, and for printing two, three, four and five colours.

They are built with Messrs. Hoe's full automatic suction feed and semi-automatic hand feed, with automatic front and side positive register mechanism. Pile delivery is furnished as part of the regular equipment of these presses for delivering the sheet printed side up approximately four feet from the floor and with all the necessary pile raising and lowering devices which are operated by power.

The impression cylinder revolves, surrounded by either two, three, four or five direct printing units, thus carrying the paper into successive contacts with plate cylinders

without transferring sheet until printing operation has been completed.

The normal ink unit of the multi-colour press consists of five forme rollers of large diameter with oscillating rollers and ink drum, giving ample distribution. The dampening mechanism is of similar construction to that used on the offset press, and the water supply can be regulated to any degree of fineness desired.

Cylinder trip and ink trip on a multi-colour press are entirely automatic, requiring no attention on the part of the operator, as presence of sheet properly held actuates the mechanism, so arranged that no partial prints are acquired.

THE FUCHS AND LANG MANUFACTURING CO., NEW YORK.

In 1907 this firm made the Rutherford offset rotary, and at present still make the Rutherford metal plate decorating machine, with all the most modern improvements:—Pile feed, automatic registering, full automatic trip. The water duct has a fine variable control. The feed pile rises regularly to feed level. They recommend the use of printing plates of .014 in. thickness.

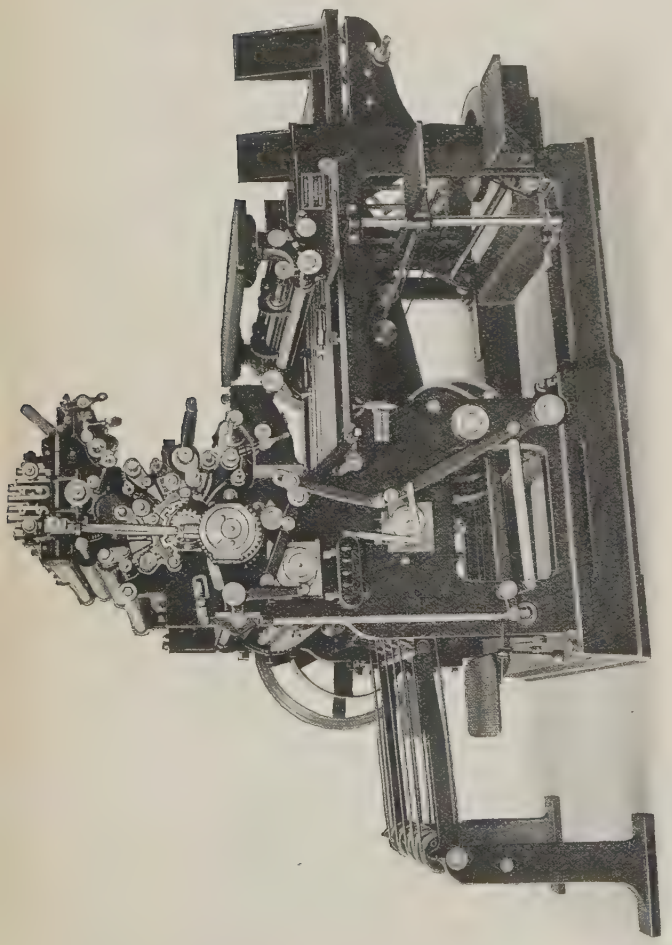
It is made in two sizes:—Plate, $37 \times 28\frac{3}{4}$ in.; floor space exclusive of delivery tapes, 11 ft. $3\frac{1}{2}$ in. $\times$ 8 ft. 3 in.; speed per hour, 1,500 to 2,500; weight, 18,000 lbs.; motor, 5 h.p. Plate, $35 \times 28\frac{3}{4}$ in.; floor space exclusive of delivery tapes, 10 ft. $\times$ 6 ft. 9 in.; speed per hour, 2,500 to 3,000; weight, 11,000 lbs.; motor, 3 p.h.

THE POTTER OFFSET MACHINE.

The Potter offset manufacturers claim, and not without reason, that they were the first makers of an offset machine for printing on paper in 1906, at the time when J. W. Rubel showed by his machine the possibility of offset printing on paper.

From that early beginning the Potter offset has been constantly improved and stands in the first rank of American built machines.

It is now made in the compact form, having the three cylinders arranged in L fashion. The three cylinders are of the same diameter. The feature of the machine is that



Improved Rutherford Rotary Metal Decorating Machine.
The Fuchs & Lang Mfg. Co.

the grippers close upon the sheet before the front guides move, and at the correct time they move in the direction of the travel of the sheet. As soon as the sheet has passed, the guides return to position, whatever length the sheet may be. The inking is of the best arrangement, securing that the ink is well distributed before it is passed to the plate rollers.

The feed may be by hand or automatic feeder, and the delivery is face up, which by the way, they claim to be the original introducers. The check or trip is actuated by pedal, when hand fed, or automatically when a mechanical feeder is used. It trips the printing cylinders, the ink distribution is checked and the supplies of ink and water are cut off at the ducts, without stopping the machine. There are also the usual hand levers to perform these several checks independently.

These machines are made in seven sizes:—From (paper size) 28 × 22 in. to 64 × 44 in., the dimensions being length from 6 ft. 6 in. to 11 ft. 2 in., width 5 ft. 11 in. to 11 ft. 6 in., and height 5 ft. 11 in. to 8 ft. 11 in. for hand fed machines, requiring power of 2 h.p. to 9 h.p., and run at a high speed. When an automatic feeder is attached the length of the machine is increased by 3 ft. up to 5 ft. 6 in.

The smallest machine weighs about 2 tons $1\frac{1}{2}$ cwts., and the largest 11 tons $9\frac{1}{3}$ cwts.

The firm also makes a two-colour offset machine, with all the latest improvements.

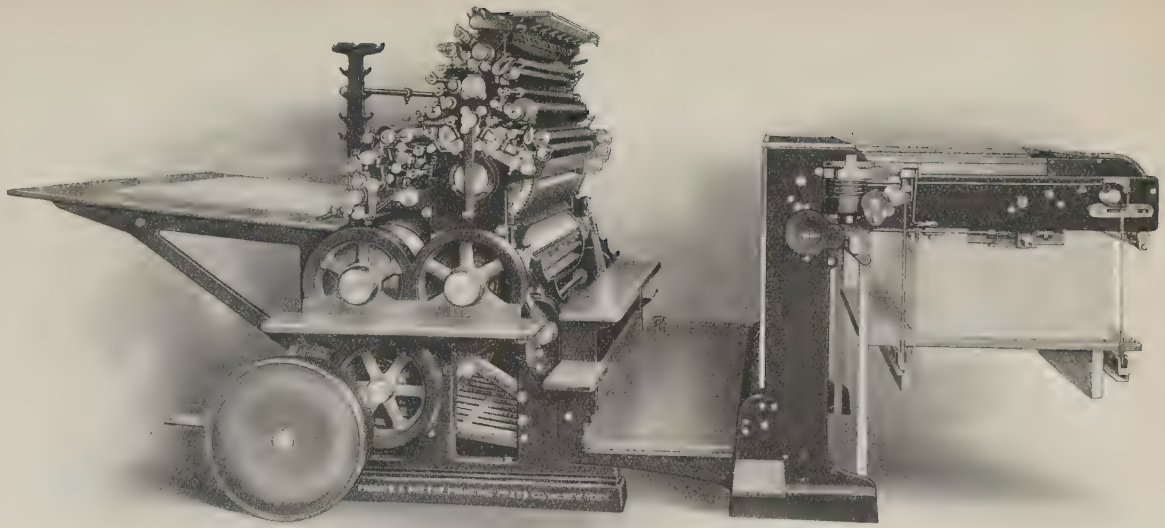
In Great Britain the agents are Messrs. Walker Bros., Great New Street, London.

MASCHINENFABRIK AUGSBURG-NURNBERG A.G. WERK AUGSBURG.

M.A.N. ONE-REEL OFFSET ROTARY MACHINE.

An interesting innovation in the field of offset printing is the one-reel offset rotary machine of which the M.A.N. has supplied a great many firms inland and abroad (see the illustration on page 242).

The machine is of low and very rigid construction and, although it is compact and occupies small space, yet it is very accessible. It comprises a printing unit each for first and second printing according to the three-cylinder system. The printing units are placed in the middle and at half the height of the machine, therefore they are within easy reach of

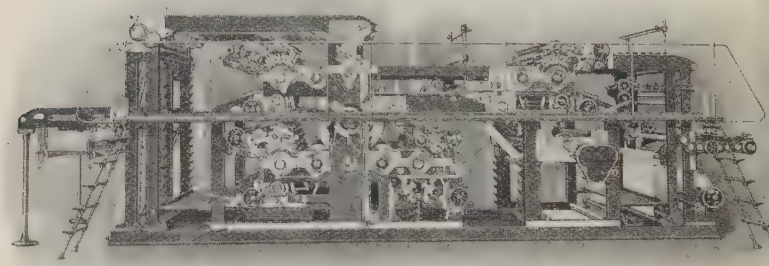


SINGLE-COLOUR ROTARY OFFSET MACHINE WITH PILE DELIVERY.
PREMIER & POTTER PRESS CO.

the machine minder, and always under his control. The rubber blanket cylinders are fitted with devices for clamping the rubber blanket, and the plate cylinders have the same for mounting the zinc plates.

The two inking mechanisms each consist of three inking rollers with leather covering, duct roller with movable stepped eccentric, so that it may be thrown in and out during the running of the machine; one large and two small distributing cylinders with rapid lateral motion, four distributing rollers with leather covering and a vibrator. These inking mechanisms are constructed according to the latest experience and give a very thorough distribution. The amount of ink can be regulated according to requirements by a handle. All rollers of the inking mechanism can be raised by hand or automatically on stopping the printing operation, and at the same time the ink feed from the ink duct is stopped. The ink ducts of latest and generally acknowledged design are equipped with resilient ink knife and many adjusting screws.

The damping devices with two-plate rollers are located under the plate cylinder, according to an approved system, and thereby preventing any sprinkling of water on rubber and impression cylinders.



One-Reel Rotary Offset Machine to Print One Colour on First Side and Three Colours the Other Side. Web Printing. "M.A.N."

They are adapted to be finely adjusted to obtain the required pressure against the plate cylinder, by means of which the degree of damping may be regulated within wide limits.

By eccentrics the water feed may also be exactly regulated and the duct roller shaft of the water duct put out of action at any time by means of a hand wheel, thus eliminating the dangerous wiping by hand.

Stopping of the printing operation is effected from the position of the machine minder attending to the delivery, the impression cylinders being disengaged and the inking rollers lifted, the supply of ink being stopped at the same time.

A tapeless folder running in self-lubricating bearings, arranged for copies cut up and folded half-page size and consisting of an assembling funnel with longitudinal cutter, cutting, assembling and folding cylinders, sheet delivery on endless band and counting device are essential parts of the machine.

The speed of this machine is 6,000 cylinder revolutions per hour, viz., the machine produces, per hour, up to 6,000 copies of sixteen pages, or up to 12,000 copies of eight or four pages, all folded page size.

DESCRIPTION OF THE M.A.N. REEL-FED OFFSET ROTARY MACHINES FOR ONE-COLOUR PERFECTING AND TWO-COLOUR PERFECTING.

The nearly unlimited field of offset printing induced this firm to build an offset machine for printing sheets as well as a machine for printing from the roll.

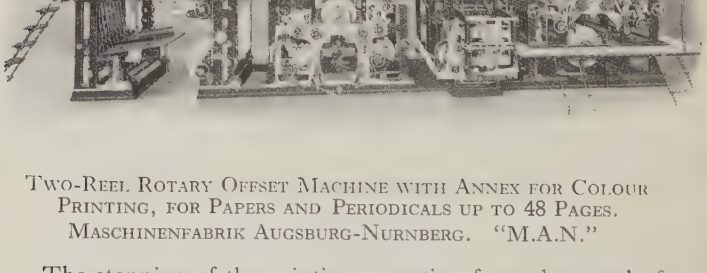
The following is the description of the machine. The machine is very low and rigidly constructed and of easy and commodious accessibility. It consists of a printing unit for first and second-side printing according to the three-cylinder system. The printing units are situated at half the height of the machine and easily accessible and controlled by the machine minder. The rubber blanket cylinders are provided with devices for mounting the rubber blanket, the plate cylinders with same for fastening the zinc plates.

The two inking mechanisms each consist of three plate rollers with leather covering, duct roller with fine adjustments which can be varied during the running of the machine, one large and two small distributing cylinders with rapid lateral motion, four distributing rollers with leather covering

and a vibrator. These are constructed according to the latest experience and give a very thorough distribution. The amount of ink can be regulated by a handle. All rollers of the inking mechanism may be raised by hand or automatically on checking the printing operation.

The ink ducts of latest and generally acknowledged design are fitted with resilient ink knife and many adjusting devices.

The damping devices with two plate rollers lie according to the generally acknowledged way under the plate cylinders and prevent sprinkling of water on the rubber blanket and impression cylinders. They are fitted with springs and can be set to the plate cylinder according to the pressure required. An absolutely irreproachable damping is thereby obtained which is essential for good printing. Furthermore, the water supply can be finely adjusted, thus avoiding the dangerous wiping by hand.



Two-Reel Rotary Offset Machine with Annex for Colour Printing, for Papers and Periodicals up to 48 Pages. Maschinenfabrik Augsburg-Nurnberg. "M.A.N."

The stopping of the printing operation from the stand of the machine minder separates the rubber blanket cylinder from the plate and impression cylinders and lifts the inking rollers from the zinc plates.

A tapeless folder devised for copies cut up and folded half-page or page size composed of an assembling funnel with longitudinal cutter, cutting, folding and assembling cylinders,

sheet delivery on endless band and counting device, are essential parts of the machine.

The speed of the machine is 6,000 cylinder revolutions per hour; the machine supplies per hour up to 6,000 copies of sixteen pages, or up to 12,000 copies of eight or four pages folded column size.

They build this machine also for perfecting in several colours, the machine forming thus an unequalled novelty.

The two-colour perfecting machine has the same arrangement of inking and damping mechanism and the checking as the one-colour machine.

The paper web is printed on both sides in one colour by the lower printing units and then the second colour is printed on each side by the upper printing groups. It can also be arranged to have one colour printing on first and second sides by printing from two rolls.

The output of the two-colour machine is the same as for the one-colour machine, viz., 6,000 copies of sixteen pages and so on, when printing one colour from two reels the copies are twice as many, that is to say, 6,000 copies of thirty-two pages, and so on.

One of the latest offset machines they have produced is for fixed and variable sizes to print one colour on the first side and three colours on the second. This is being used by a large firm of printers on the Continent for printing cartons, posters, labels, circulars and similar work in large quantities. The machine prints from one reel and is equipped with a flat delivery and also a re-reeling device for producing simultaneously four narrow reels side by side.

This machine consists of the usual unit of three cylinders, as already described for printing the first side of the sheet, and for the second side three perfecting printing groups comprising in all, three rubber cylinders, three plate cylinders and three inking and damping units, working conjointly with one impression cylinder of double the diameter of the plate and rubber cylinders.

When printing on both sides of the maximum sized paper, the web is passed first through the three-cylinder unit and then through the remaining three units. For printing one, two or three colours on one side only, the paper is fed direct to the impression cylinder of the perfecting units, avoiding the first group.

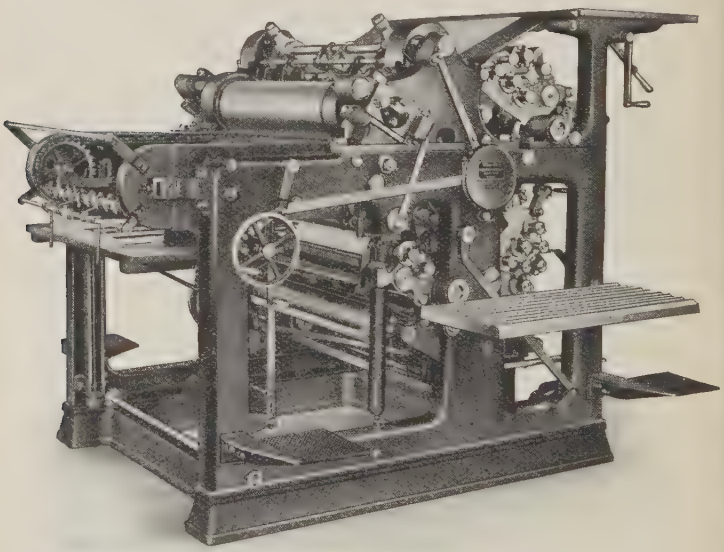
When using either of these methods, the paper web is either re-reeled or cut to length and passed to a collecting cylinder, whence sheets are delivered flat in lots of five.

For printing sheets less than the maximum size, the web is first cut to the required length on the machine and the cut sheets conveyed to the impression cylinders which are provided with grippers to hold the sheet securely.

The output of this machine reaches 10,000 sheets per hour, $41 \times 27\frac{1}{2}$ in.

The foregoing information will give some idea of the wide scope of rotary offset work from the reel, and the varied activity of M.A.N. in producing machines to encourage and fill the demand.

The British representatives are Messrs. A. H. Lakeman, Ltd., Belvedere Road, London, S.E.



"Bautzen" Two-Cylinder Two-Colour Offset Machine.
Johne-Werk Co.

THE "BAUTZEN" TWO-COLOUR TWO-CYLINDER OFFSET MACHINE. JOHNE-WERK CO., BAUTZEN.

The "Bautzen" is the only machine of its class on the market. It is simple in construction and unusually compact, with nevertheless plenty of room for carrying out the various operations. There is an automatic check to the impression, and the ink and water supply. No trouble from "gear marks" is experienced on this machine.

The basis of construction is a rubber blanket cylinder of a certain diameter, and a second cylinder three times its diameter to carry the two printing plates and the impression surface.

The ink from the first plate is deposited on the rubber, immediately followed by that of the second plate, and the combined result is transferred to the paper held by grippers on the third sector or impression surface.

Although there is some prejudice against this method, the results obtained prove that the machine is a practical proposition and produces results which are reliable.

It is made to print on paper, $20\frac{1}{2} \times 28$ in., and its dimensions over all are 8 ft. 0 in. × 7 ft. 9 in., height, 5 ft. 7 in. With automatic feed the speed is 3,000 and more per hour.

The British representatives are Messrs. A. H. Lakeman, Ltd., Belvedere Road, London, S.E.

VOGTLAENDISCHE MASCHINENFABRIK A. G. "VOMAG" OFFSET PRINTING MACHINES.

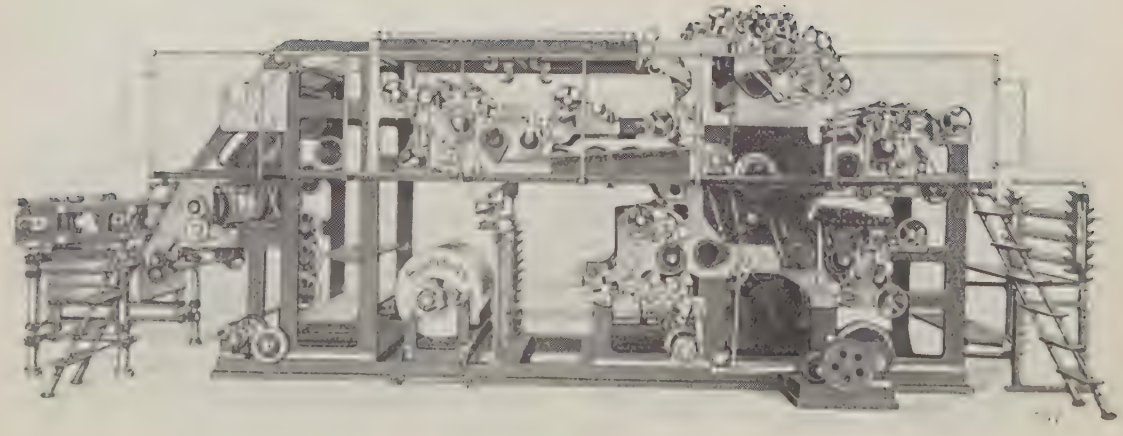
(Contributed).

THE FIRST FOUR-COLOUR SHEET-FED OFFSET MACHINE.

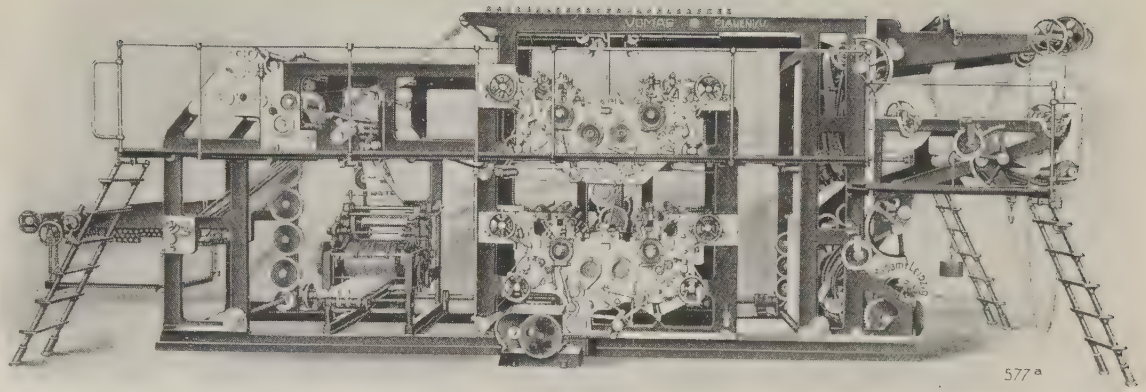
Whereas single and two-colour sheet-fed offset machines have reached a considerable state of perfection and are capable of noteworthy achievements, the question of three and four-colour printing in one operation by the offset process had up till now not been attempted.

The Vogtlaendische Maschinenfabrik A. G. Plauen im Vogtlande, which in the year 1910 placed the first web-offset perfecting rotary on the market, decided to use their experience and ability in the production of such a machine.

Every printer knows that the solving of such a problem as printing four colours in one operation is of the greatest commercial importance, but no one will deny that to be the first



"Sanbas" Single-Reel Offset Rotary.
To Print on Web, One Colour One Side and Four on the Other.
"Vomag." Soldans, Ltd.



"Messamt Leipzig" Single-Reel Offset Rotary.

To print on web, either (1) two-colour perfecting, (2) one-colour one side and three on the other side, (3) two colours on one side only; and as a two-reel machine it is used for single-colour perfecting. Double production.

Vogtlaendische Maschinenfabrik A.G. "Vomag." Soldans, Ltd.

to construct such a machine is not devoid of a considerable element of chance and requires taking one's courage in both hands. That the difficulties encountered have been successfully overcome is shown by the excellent specimens of printing obtained from the machine on its trial run. That the technical difficulties of construction were not small is witnessed by the fact that the larger counter cylinder has a diameter of approximately seven feet, but thanks to the wide experience and the excellent workmanship of the "Vomag" they have produced a machine which will comply with the most searching requirements of the printer.

The output of the machine is 2,500 sheets printed in four colours per hour, and the saving against single-colour machines is thus seen to be great both in time and cost. Positive register is guaranteed and a particular advantage as against printing on single-colour machines is the fact that the colour regulation can be controlled at the beginning of the printing and the final effect judged at once. By printing wet-on-wet superimposed the desired half-tones, which give a result both of life and colour, are obtained.

This machine is suited for the finest colour work as well as for everyday commercial work; its main advantages can be shortly summarized as follows:—

1. Absolute positive register as the sheet receives the four colours in one operation and is held by one set of grippers the whole time.
2. High output. The output is considerably more than that possible by using single-colour machines which on quality work would not be run at greater speed than the four-colour machine.
3. The advantage of regulating the colour supply in order to obtain the desired result right from the beginning of the run.
4. Production of four-colour work ready for immediate use.
5. 50 per cent. saving on a large part of the cost, while giving treble output. 50 per cent. saving of space. Considerable reduction of loss by waste.

METHOD OF OPERATION AND CONSTRUCTION OF THE PRESS.

The sheet is gripped by oscillating grippers and accelerated up to the speed of the large impression cylinder, whose

circumference is divided into four sections of equal size, each provided with a set of grippers.

The sheet is held by the grippers during the whole revolution of the cylinder from the beginning of impression to delivery. Delivery is on to a pile table with the printed side upwards. The four impression units, each of which consists of a blanket cylinder and plate cylinder with inkers and dampers, are so arranged around the large central cylinder that the commencement of impression between the blanket and plate cylinders on the one hand and the blanket and impression cylinder on the other hand, is simultaneous; by this means shock or vibration of any kind during the time of printing is entirely obviated. A special device is provided to put on or take off impression and this always commences at the first impression unit. The other impression units then follow in turn so that the following sheets either receive all four colours or are delivered clean, thus avoiding all spoilage.

It may be said in short that the machine is a product of the best technical experience available to-day, and in the realm of colour printing affords a commercial proposition without a rival.

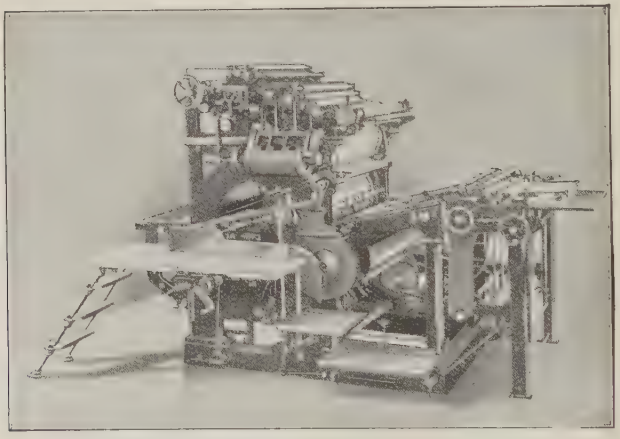
This firm makes various web rotary offset machines, such as the "Stuttgart," for single colours, back and front; "Nordhausen," for three colours on one side, or two colours on front and one on the back; "Sanbas," the four-colour machine, and the largest rotary web offset machine in the world, as supplied to Melbourne, Australia.

The London agents are Messrs. Soldans, Ltd., Eagle St., Holborn, W.C.

J. G. MAILANDER'S OFFSET MACHINES.

The single-colour rotary offset machine is built with the plate cylinder at the top, with the whole inking apparatus arranged above it and the damping apparatus placed parallel to top of the cylinder, over the feed board. The blanket cylinder projects at the back, about a quarter of its diameter. This allows for the impression cylinder being placed further under the feed board, and with its topmost edge (its crown) almost as high as the centre of the blanket cylinder. This arrangement gives compactness, without any hindrance to accessibility.

The register is effected by front and side lays as in a letter-press machine. The feed may be hand, or by their own automatic feeder, which occupies less than twelve inches extra over the stock board. Other automatic feeders can be attached. The delivery is effected without fliers or tapes, and the sheets are delivered face up, on a board or automatic pile delivery. The grippers on the chain take the printed sheet before it is released by the grippers of the impression cylinder.



J. G. Mailander's Single-Colour Rotary Offset Machine with Automatic Feed.

The (zinc) plate is first screwed in stretching bars and then fixed on the cylinder. When so fixed the cylinder can be adjusted to obtain the correct position, even should the plate have been fixed not quite straight.

In the inking apparatus there is ample distribution, and the four plate-inking rollers are of different diameters.

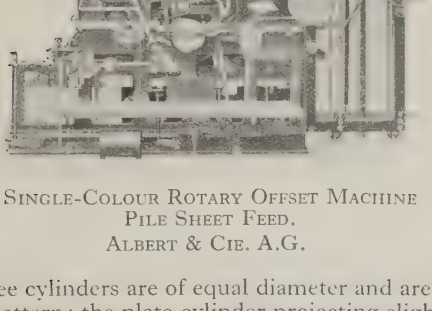
The maker claims that the brass roller in the damping apparatus is not used as a conveyer of moisture. It seems from this that the original idea of the use of a brass roller as a rider to collect dirt from the dampers is uppermost in Mailander's construction.

The check or trip stops the ink and water supplies, and draws back the bearings of the blanket cylinder. This movement is not dependent upon eccentric bearings.

The machine is made in four sizes, for paper $27\frac{1}{2} \cdot 19\frac{1}{2}$ in., $32 \cdot 24$ in., $41\frac{1}{2} \cdot 29$ in., and $47 \cdot 35\frac{1}{2}$ in.

ALBERT AND CO.—OFFSET MACHINES.

The "Frankenthal" offset rotary machines are made by Albert & Cie A.G., Frankenthal. This firm claims to be the largest printing machine manufacturers in Europe. Their direct rotaries have been on the market for more than thirty-five years, and their offset rotaries have been made for at least fifteen years. They made a new model in 1921 and have since added so many improvements that it appears to be as well made as the best of the English machines.



Single-Colour Rotary Offset Machine
Pile Sheet Feed.
Albert & Cie. A.G.

The three cylinders are of equal diameter and are arranged on the L pattern; the plate cylinder projecting slightly at the back of the machine. The pressure can be adjusted between the plate and rubber cylinder, or the impression and rubber cylinder.

The offset or rubber cylinder is provided with two blankets, one over the other. The upper blanket can be tightened at both edges.

A special feature of the plate cylinder is that the surface is slightly raised at the back and front edges of the flat, to

keep the blanket or rubber cylinder from coming in contact with edges of the plate at the front and back where ink and moisture usually accumulate.

The plate-locking device embodies the means of adjusting the plate from back to front, from side to side, and diagonally. This consists of two rotating clamps in grooves, forming a narrow band on the plate at the edge of the cylinder.

The inking apparatus consists of four nap rollers, with leather covered distributors, a distributing cylinder, four oscillating distributors, one non-oscillatory distributor, one leather vibrator and the duct roller. The knife of the duct is easily removed.

The inkers are in bearings which move them round the distributor just enough to clear the plate when checked or tripped.

The lateral oscillation of the distributors can be regulated from nil up to $1\frac{1}{2}$ in.

The ink duct projects somewhat at the back of the machine, but by this arrangement the regulating screws can be adjusted from the floor, in the single-colour machines.

The damping apparatus is of the usual type, but the conveyer oscillates slightly, and the dampers are in spring bearings, so that they always press on the plate. The water supply can be regulated to any extent, by a lever.

The check or trip is actuated by a pedal, and it separates the three cylinders, lifts the inkers, and stops the ink and water supplies. The inkers or dampers can be thrown out of action by levers, and any error of feeding actuates the complete trip.

The feed may be by hand or automatic feeder. The front lays do not lift until the grippers close, and they then swing forward in the direction of the travel of the paper. The register front lays are of metal lighter than aluminium.

The automatic feeder is usually built to the machine, and to increase the speed of printing the suction tubes have been shortened. The feeder is fed from a tall pile; the stock can be easily renewed by introducing a new pile.

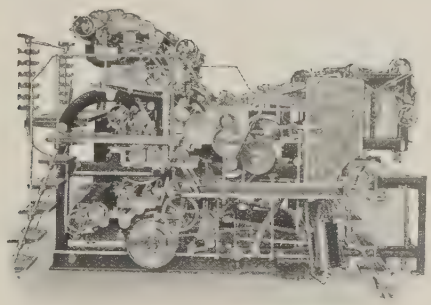
The delivery is by a drum, which takes two sheets at a time, thus assisting to increase speed. From the drum the sheets pass on a short carrier to the delivery at the back of the machine. The pile may reach 13 in. high, and the table can be readily replaced.

The single-colour machine is made in four sizes to take plates of 25 B.W.G., and of the dimensions:—31½ × 27 9/16 in., 41 × 36 3/16 in., 46 7/8 × 39 3/8 in., and 53 9/16 × 44½ in.

TWO-COLOUR OFFSET ROTARY.

The construction of this machine in its details is the same as the single-colour machine. There are two plate cylinders which successively leave their prints upon two blanket surfaces on the rubber or offset cylinder, and the paper on the impression cylinder takes the two-colour print.

It is fitted with automatic pile feed and pile delivery, and is made in one size for plates 23 B.W.G.: 46 7/8 × 39 3/8 in., and gives 2,400 impressions per hour. Its dimensions are:—



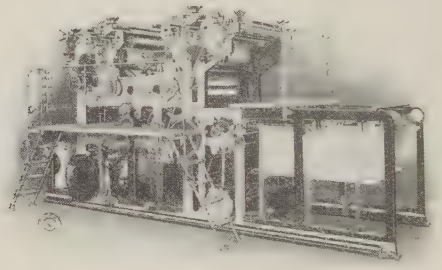
Two-Colour Rotary Offset Machine with Pile Feed.
Albert & Cie. A.G.

length, 13 ft. 9 in.; width, 9 ft. 10 in.; height, 9 ft. 4 in., and weight about 13 tons 12 cwts.; h.p. required, 8½; or with automatic feeder, 9½ h.p.

ROLL-FED OFFSET ROTARY.

This firm also makes a roll-fed rotary, with the necessary cutting apparatus to cut the sheets to accurate measurement as fed.

The British agents for these machines are Messrs. Price, Service & Co., Norfolk House, Norfolk Street, London, W.C. 2.



Reel-Fed Rotary Two-Colour Offset Press.
Albert & Cie. A.G.

CHAPTER XIX.

ELECTRIC MOTORS.

As electrically operated motors possess such distinct advantages it will not be out of place to give a few remarks upon them.

In the general way the machine room is fitted up with shafts and countershafts, attached to the ceiling and carried on wall brackets, from which the belts are suspended to conduct the power to the machines. The belts are in many cases an impediment to free access to the machines, especially as each belt must have a wood or wire guard. The shafting and pulleys must be kept clean and well lubricated, with the possibility of oil being sprayed into the room or dropping upon work or persons. The practice of driving from one main shaft necessitates that it must be constantly running in work rooms where many machines are in one room. The power generated by the driving engine or engines suffers considerable loss in simply driving shafts, countershafts and pulleys, and the belts are largely responsible for the dust and dirt in the air of the room.

This waste of energy and the other inconveniences are largely eliminated by using independent motors, one to each machine.

ELECTROMOTORS, LTD.

This firm has installed over 5,000 electric drives to printing machines, and during its twenty-five years' experience has evolved a number of types of motors, suitable for direct or alternate current. They are made for building into the machine frames or to stand on their own bases in the most convenient positions close to the machine, driving by belt and jockey pulley. A special feature of their equipment is the starting switch. The ordinary type of hand starter is unsuitable for flat-bed machines, because the frequent starting and stopping is performed on the first two or three

contact studs of the starter, when frequent destructive arcing rapidly wears away the contacts and burns out the resistances. To counteract this they have made a drum type controller which can be fitted by the feed-board. It is electrically connected to a single-pole magnetically operated contactor, by which the circuit is "made" and broken. The controller is fitted with renewable hinged fingers and drum contacts, and the contactor has carbon contacts, powerful magnetic blow-outs, and arc shields. The whole device enables the operator to inch the press as often as may be desired.

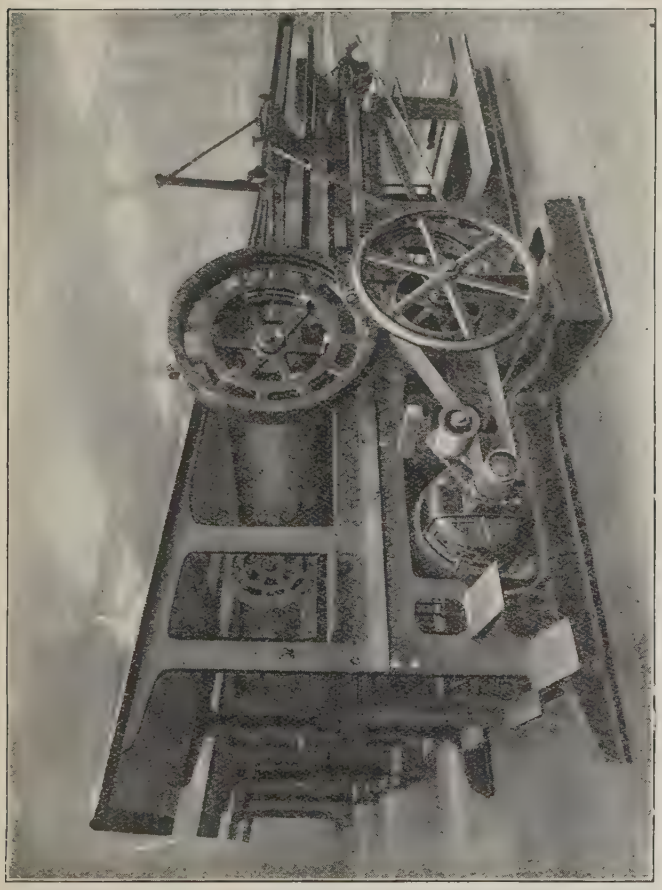
The most efficient starter is the Fully Automatic Control Gear, in which a small auxiliary switch is fixed close to the feed-board. This switch has two push buttons, one for slow motion, or "inching," the other for the "run," and it has a small handle to stop the machine. This switch is connected with the actual starter placed below near the motor, or fastened on a wall close by. It is a box with a glass door, containing a slate slab for the electric gear. This gear comprises a single-pole magnetically operated contactor which takes all the "makes" and "breaks."

The contactor is electrically interlocked with an automatic self-starting rheostat for bringing the motor up to speed, and the speed of starting up can be controlled over wide limits by a special retarding device. The speed regulator is so arranged that the machine always starts on the lowest speed and runs up automatically to the speed for which the regulator has been set.

The speed of motors can be regulated within a predetermined range to suit the work and class of paper in hand.

This form of control has been largely adopted, and Electromotors, Ltd., of Openshaw, have put one hundred equipments in each of four English works, as well as twenty-five to seventy-five each in many others. Several of the leading printing machine makers attach their motors to machines.

Regarding the care of motors it is understood that with motors and control gear of robust design and good workmanship care and maintenance are reduced to a minimum. The addition of a little fresh grease to the motor bearings at intervals of six months and an occasional inspection of the carbon brushes is all that should be required. As these brushes wear away provision is made for maintaining the spring pressure, and when it becomes necessary to renew the carbons, the operation is quite simple.



Jockey Pulley Drive on Miehle Two-Revolution Machine—Motor in Machine Frame. Electromotors, Ltd.

THE BRITISH THOMSON-HOUSTON CO.

The extensive practical experience which this firm has had in electrifying printing and allied works should be a guarantee of their ability successfully to apply electric drive to lithographic and general printing machinery, as well as to the larger printing plant associated with the production of newspapers, etc.

Three types of direct current motors manufactured by this firm—known as Types DQ, DR and UD—cover the usual requirements for this class of drive. These motors may be of the protected, enclosed-ventilated, drip-proof, or pipe-ventilated patterns, depending on actual requirements; for example, if the motor be located in a situation where dripping water is likely to be experienced the drip-proof machine would naturally be chosen. The machines are reversible; that is to say, they can be run in either direction as desired.

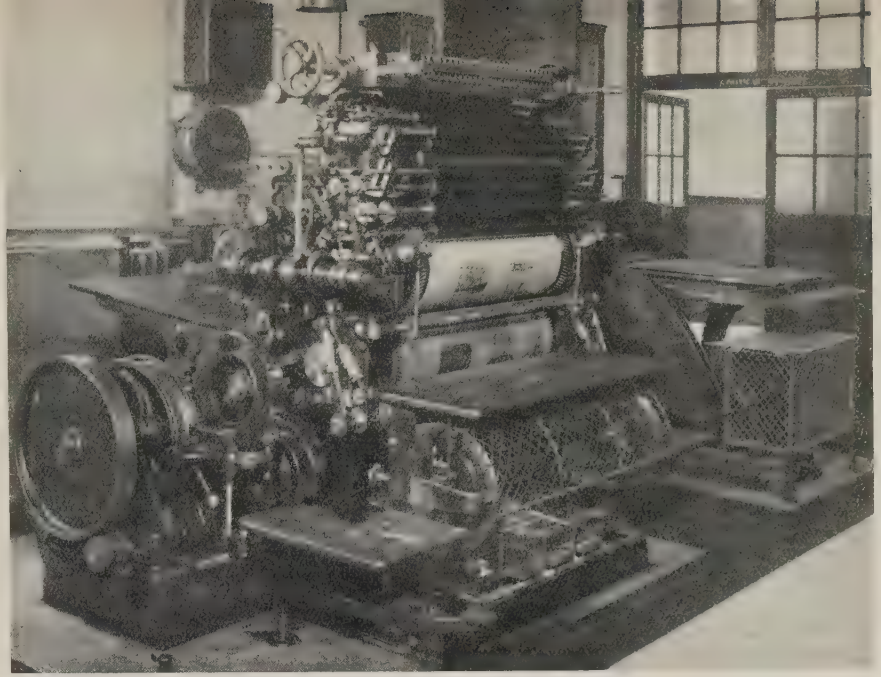
The Type UD motors are a recent development. They have a roller bearing and a ball bearing (at driving and commutation ends respectively), and can, therefore, be fixed at any angle, provided the shaft be horizontal.

Many installations employing direct current drive are to be found; but to-day it is by no means essential that direct current be available; the B.T.H. Co. has successfully applied alternating current motors, both constant speed and variable speed induction motors, and variable speed A.C. commutator motors. The latter machines offer many advantages and are possibly superior to any other drive whether A.C. or D.C., since an extremely wide variation of speed is possible, whilst at all speeds the power input is directly proportional to the load.

The A.C. commutator motor has been successfully applied to a large number of industrial drives, notably for paper making, printing processes, calico printing, etc.

To the machineman, ease of control is perhaps one of the more obvious advantages which electric drive has to offer. Modern electrical control equipments enable the press to be started, "jogged" or stopped at will by means of push buttons located anywhere on the press convenient to the operator.

Even with small machines, where automatic electric starters are not employed, "stop" buttons may be supplied for shutting down at once in cases of emergency.



B.T.H. 2 H.P., 600/1800 R.P.M., DIRECT CURRENT MOTOR, ON MARINONI-VOIRIN ROTARY OFFSET MACHINE IN THE LONDON SCHOOL OF PRINTING.

The B.T.H. control gear for this press comprises a series contactor starter with "start" and "stop" push-button control; speed variation is effected by the shunt field rheostat mounted below the starter.

BRITISH THOMSON-HOUSTON CO., LTD.

The reliability and flexibility of B.T.H. Printing Press Control Gear when properly installed and correctly applied makes possible reduced running costs, unobtainable by other means.

J. H. HOLMES AND CO.

This firm has been making electrical machinery from 1884 onwards, and their motors may be found in most of the letter-press and lithographic printing works in Great Britain, and many houses abroad.

Their experience has been extensive in fitting motors on printing machines in all kinds of awkward situations, and to meet the individual cases have adopted the various driving by direct connection, spur gear, silent chain drive, long and short belts.

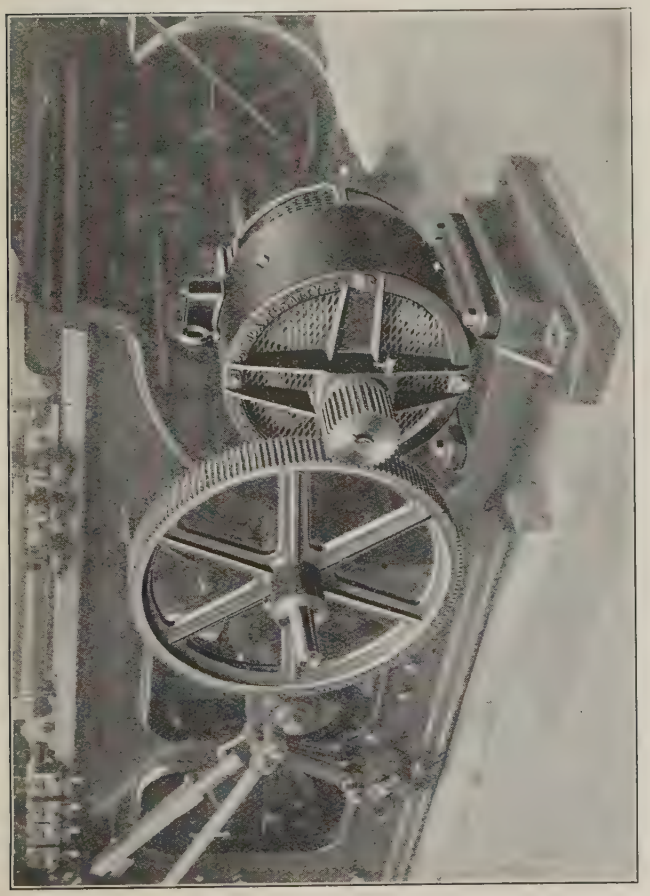
Their hand operated switch allows for the slow or "inching" motion. The motor always starts with the full strength of the field and consequently with the lowest possible current. A shunt selector switch with detachable handle is provided so that when restarting the motor, it will run up to the same speed as previously set by the foreman, without any further resetting of this switch.

Their automatic switch gear is mainly in a case fitted conveniently near the machine, the only switch on the machine is a small "pilot" or "push" switch. The points in this gear worth noticing are:—

The machine starts slowly, the speed being out of the operator's control; this allows time for preparing to feed the paper.

Small movements or "inching" are obtained by the "pilot" or "push" switch, without any detriment to the switch gear, as the main Clapper switch is fitted with large flexible contacts and powerful magnetic blow-out.

The field regulator has not less than twenty-six contacts for twenty-five variations in speed, is electrically interlocked with a starting switch in such a way that the motor always starts with a strong field, starting current is always reduced to the minimum and sparking avoided. The regulating resistance is cut in gradually, so that the speed is brought up to that which was previously set by the shunt selector switch. This does not prevent the speed being altered, even while the machine is running.



Gear Drive. Motor on Bracket, Bolted to Machine.
J. H. Holmes & Co.

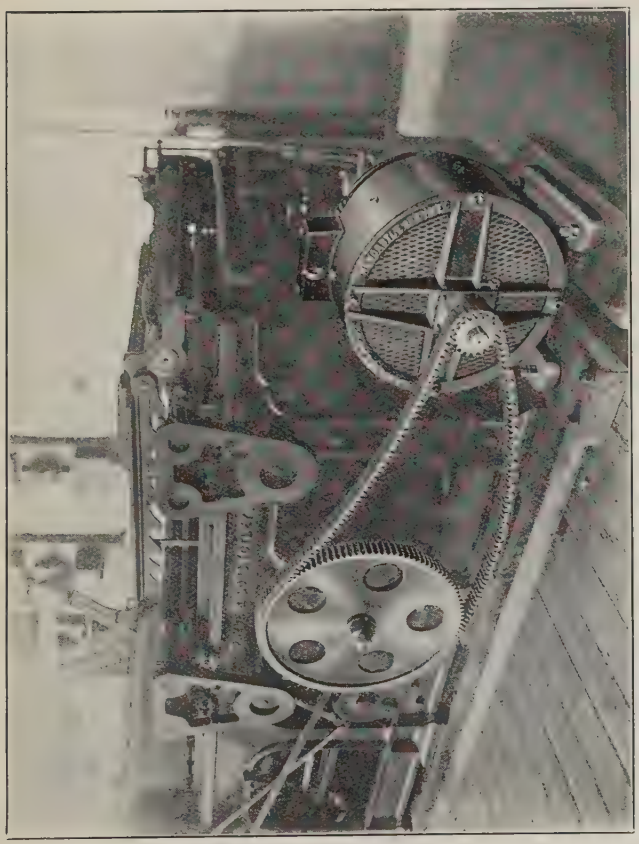
To assist in determining the horse power necessary for printing machines this firm has given the following general guide:—

Lithographic Machines	Runs per hour	H.P.	Runs per hour	H.P.
Demy ...	1500 ...	1 ...	2100 ...	1¼
Dble. Crown	1350 ...	1¾ ...	2000 ...	2¼
Dble. Demy	1300 ...	2 ...	1800 ...	2½
Quad. Crown	1250 ...	3 ...	1750 ...	3¾
Quad. Royal	1200 ...	4 ...	1680 ...	5

Their motors are of a compact, strong build.

On larger printing machines which require a greater h.p. and definite slow running and inching speeds, also a wide range of speed for printing purposes, the Holmes-Clatworthy system is used, this system being patented in 1898. This system makes use of an auxiliary motor for inching, slow running and threading-in purposes, the larger motor being used for printing speeds. The arrangement is such that the small motor is connected through worm gear and a self-releasing claw clutch to the shaft of the main motor and the printing machine or press is driven by the small motor through the shaft of the large motor. When the threading-in has been finished, and with the small motor still running, current is put upon the large motor which gradually accelerates and over-runs the speed of the worm wheel shaft which is driven by the small motor, and at this point of over-running the sliding half of the claw clutch is thrown out of gear which automatically brings the small motor to rest, the main motor is then accelerated to any speed that may be required for printing purposes.

Messrs. J. H. Holmes & Co.'s works are at Newcastle-on-Tyne.



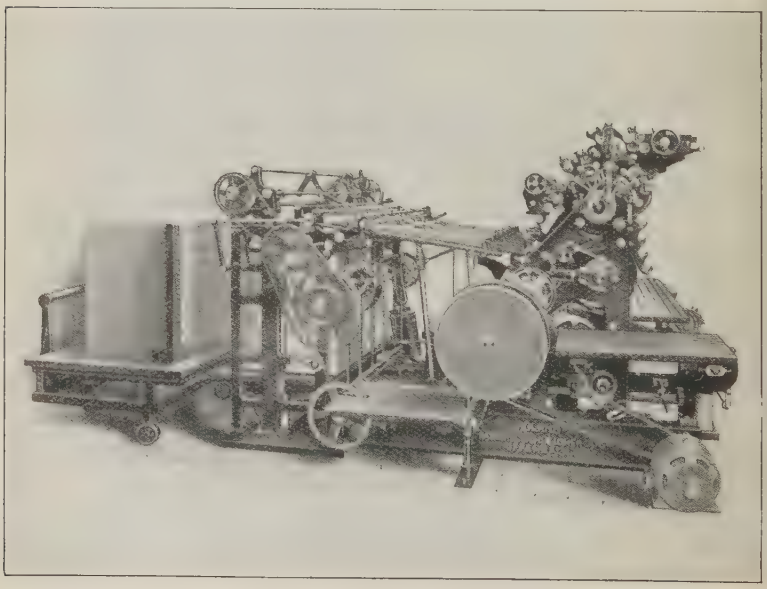
Chain Gear Drive on Two-Colour Machine.
J. H. Holmes & Co.

CHAPTER XX.

FEEDERS.

THE "UNIVERSAL" FEEDER.

THIS is the feeder so largely patronized by printing firms throughout Europe. It is rapidly gaining popularity with British and American printers. Up to recent date, some 10,000 of these feeders have been attached to printing machines.



"UNIVERSAL" FEEDER ATTACHED TO AN OFFSET PRESS.
KLEIM & UNGERER.

It is of a fully automatic principle, working from a pile and employing both air blast for sheet separation, and suction for lifting off and starting the sheets. The actual feeding operation can be very simply explained as follows:—

The top sheet is sucked up to the rubber-faced nozzles of the suckers, shaken free from the rest of the pile by the tilting action of the suction bar, further separated and freed from dust by the air blast which is directed between the top and the underneath sheets of the pile, and, finally, carried by the forward movement of the suction bar into the transport rollers and tapes, where it is slowed down, carried to the front lay marks, mechanically registered to the side lay mark and fed into the grippers of the press.

If, for any reason, a sheet is not fed, electric contacts, mounted on the inclined feed board, create an electric short circuit, and the action of the feeder is immediately stopped. In the case of offset or direct rotary presses, the impression cylinder is simultaneously lifted or checked, so that the press continues to run, but without feeding or printing. These contacts and checking devices are operated by the electric current utilized for driving the press, but in cases where the press is driven by other means and no electric current is available, a small auxiliary dynamo is supplied by the makers of the feeder, at a trifling extra cost. This small dynamo, when attached to any convenient shaft on the printing press, generates the current necessary to operate the electric "cut-outs."

The rising movement of the pile table is governed by a feeler on the top of the paper pile, which actuates a ratchet movement the instant the height of the upper surface of the paper pile falls below a pre-arranged point, and as soon as the ratchet movement, in conjunction with the elevating screws, has raised the paper pile table to the required height, the ratchet movement is automatically disengaged. It will be seen, therefore, that there is no difficulty whatever in feeding either tissue paper or heavy card or board. This feeder deals with equal facility with paper of any surface, substance or thickness.

One of the difficulties hitherto experienced with pile feeding is that some kinds of paper lie wavily. In other cases especially after one side has been printed, the upper surface of the paper may be either convex or concave. In the

case of suction feeders, this usually results in one or more of the suction nozzles not making contact with the paper, with the result that the suction was lost and one or more sheets missed feeding. This trouble was ordinarily overcome by putting out of action the suction nozzles which did not make contact, but this in any case resulted in loss of time.

The latest type "Universal" Feeder is, however, designed with what the makers call a "Flexible Suction System," in which every sucker is separately mounted on a delicately sprung carriage, so that all suction nozzles automatically follow the contour of the upper surface of the paper. It is claimed that this overcomes all troubles with wavy, hollow or convex paper piles.

The deep pile model "Universal" feeders can be supplied in cases where very long runs are ordinarily dealt with. On this type of feeder a pile up to 51 in., or even more, can be accommodated, if the design of the press permits. In conjunction with this type of feeder, a specially designed paper pile truck can be supplied, upon which a second pile of paper can be loaded up, in readiness for instant transfer to the loading board of the feeder when the first paper pile has been exhausted. This gives practically a continuous feeding unit.

As this feeder is driven from the press itself, it is synchronized to work at the speed of the press, regardless of any speed variations. It has been tested at high speeds and has been found to give practically hair line register at 4,500 per hour. Most satisfactory results have been secured on this feeder even in the case of fifteen-colour register work. The "Universal" feeder is to be found on practically all types of letterpress machines and on lithographic direct rotary and offset presses.

As this form of feeder does not depend upon combers or stroking wheels for fanning out or separating the sheets, it is claimed that it can be successfully employed on work where no unprinted margin exists. On label work, for instance, it is often necessary, in order to economize paper, to arrange so many designs on a plate that no unprinted margins would be left in which stroking wheels could be accommodated.

The "Universal" feeder is so arranged that in the case of very short runs, it can be almost instantly put out of action for hand-feeding.

All parts of the feeder are standardized and readily replaceable in case of accidental breakage.

Some idea of the popularity of this feeder on the Continent can be gleaned from the fact that eleven or more foreign governments have installations of these feeders, and, in quite a number of the larger printing establishments in Europe, installations of fifty and upwards are by no means rare. Many makes of printing presses—especially those of German origin—have this feeder built in as an integral part of the press. It is calculated that about 60 per cent. of the feeders in use on the Continent are "Universals," or of the "Universal" pattern.

This feeder is manufactured by Messrs. Kleim & Ungerer, of Leipzig-Leutzsch, Germany, and sold in Great Britain by Mr. A. J. Dronsfield, A.M.I.MECH.E., of 25 Lime Street, London.

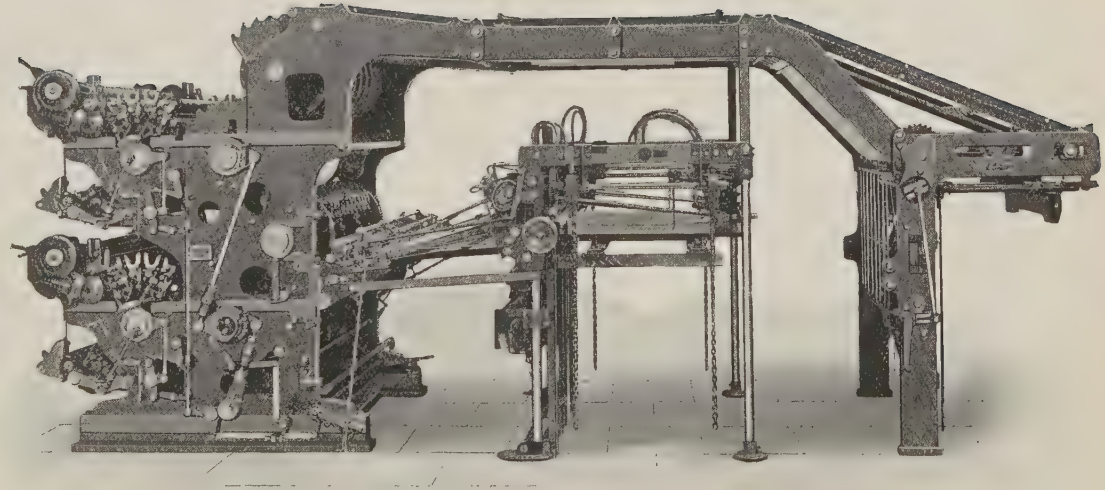
THE "DEXTER" FEEDER.

This well-known and widely-used feeder has been in use at least twenty-five years on most makes of printing machines and folders. It may be considered as one of the first of its type to be introduced and to give satisfactory results in its early days.

It is fully automatic, and largely actuated by air currents in the sheet separation prior to the mechanical transport to the side register gauges and grippers.

In working the feeder the front edge of the pile is actuated upon by rubber nozzle suction tubes, while at the same time either one or both of the corners at the back of the pile are separated by the revolution of a disc or platen assisted by a separator or comb. In these operations a clamp or presser foot slips under the top sheet as it is lifted, pressing down on the pile and through it is ejected a current of air which floats the top sheet free, and allows it to be advanced to the drop rollers. These drop rollers advance the sheet to the front end conveyers, and thence down the tapes to the register gauges and machine grippers.

Every part of the mechanism is governed accurately by suitable devices which are easily adjusted. It is by this means that sheets with printed matter upon them that may not be quite dry can be fed without damage. The callipering device is set to allow only one sheet to pass forward freely;



"Dexter" Feeder on a Crabtree Two-Colour Offset Machine.
The Sheridan Machinery Co., Ltd.

if two sheets get into it the check or trip action operates and stops the press. The suction air tank and the blast air tank can be regulated very minutely to govern the amounts in both cases to suit the varieties of paper used.

The pile skids are interchangeable so that there is little or no delay in renewing the supply of paper while the machine is running.

The feeder, as a whole, has sufficient adjustments to make it available for any kind of paper from the thinnest up to card of .025 in.; and its delicacy of manipulation makes it suitable for feeding where little or no margin is left by the design or printed matter.

The feeder is built in all sizes to suit all makes and sizes of letterpress machines, direct and offset lithographic machines, and cutting and creasing presses. The driving power is direct from the printing or other machine and does not require any increase in h.p. The air pump and pile elevator are driven by a motor supplied with the feeder. From the above statements it will be apparent that the feeder works at any speed at which the machine runs, and it has been tested for the finest register work with perfect satisfaction.

Up to the present time hundreds of these feeders have been installed in various parts of the world, several being in Government printing offices.

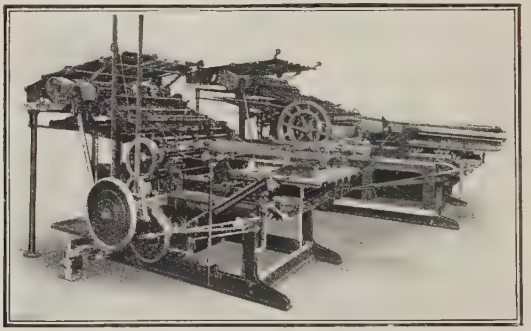
Messrs. The Sheridan Machinery Co., Ltd., Hatton Garden, London, are the suppliers of this feeder.

THE "CAMCO" OR ROTARY FEEDER.

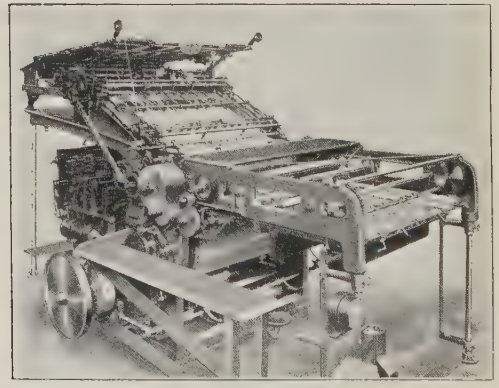
This feeder has been attached to many rotary offset, direct litho. and other types of machines, proving itself a worth while improvement over hand feeding. There are many instances where records show it works easily at an average of 2,400 per hour. As the feeder is driven by the machine, it can be geared to feed at the same speed that the machine prints, whether this speed be 1,500 or 3,500. On special types of machines the feeder can be arranged to feed as many as 6,000 sheets per hour, although for lithography this speed is not, of course, required.

It is a fully automatic feeder, of the continuous type, paper being loaded continuously without a stop. It does its work by friction rather than pressure, and no air suction or blast

is used. By this principle the sheets are separated firstly by fanning out as the pile is laid on, secondly as the stock travels round the drum, and thirdly by combing wheels which intermittently operate and rise, and can be set in any



"Camco" Feeders on Miehle Presses.
Canadian-American Machinery Co., Ltd.



"Camco" Feeder on Two-Colour Mann Offset.
Canadian-American Machinery Co., Ltd.

lateral position on the sheet. This gives a positive feed, and will feed any weight of paper from Bible paper to thick board. (In many instances this feeder is continuously feeding .025 board in exact register).

This feeder has a special and very efficient device for slowing down the sheet as it reaches the lays, and this, combined with the accurate laying devices, ensures perfect register. Should any sheet be misfed, the machine is mechanically stopped by the checks provided. This feeder has proved particularly advantageous on multi-colour work, where accurate, clean work is ranked equally with speed.

The whole feeder is of simple construction, and any change over for different sheet sizes can be effected in ten minutes. The layboard can be lifted up by simply turning a crank, and the entire feeder run back to give ready access to the printing machine. The machine is standardized in manufacture, and any replacements are easily obtainable and require no fitting.

The Camco feeder is built either for single-sheet or twin-sheet feeding, and the twin-sheet model will simultaneously feed two sheets which may be of different weight and size. The twin-sheet feeder is readily convertible into a single-sheet machine, using the entire width.

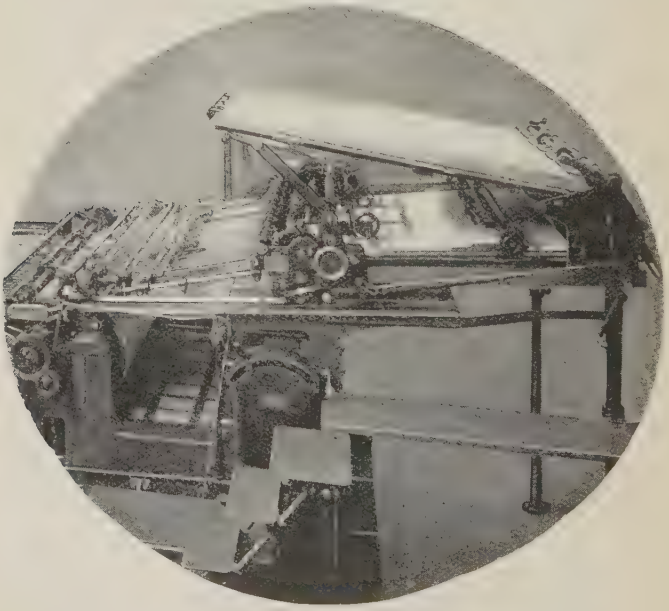
Well over 6,000 of these feeders are in use on various makes of offset and direct litho. machines, Miehle and other letterpress machines, folding machines, etc. The Camco feeder is supplied by the Canadian - American Machinery Co., Ltd., London, E.C. 4.

THE CROSS CONTINUOUS FEEDER.

Most of the well-known feeders are to a considerable extent dependent upon air suction and air blasts for the separation of the sheets. In the Cross feeder this is effected mechanically.

The Cross feeder may be distinctively termed a mechanical roll feeder. The paper is collected in suitable quantities from the reams and rolled up so as to fan it out. This roll is laid out on the upper feed board with its edges fanned out. The paper is drawn along down the board and passes round a roller in bulk. While passing round this roller the first gradual separation of the sheets commences and they are passed forward to the lower feed board.

The paper travels along the lower feed board fanned out, so that on approaching the conveyer the top sheet edge only is projecting for conveyance. As the sheet is carried to the two propelling discs, a clamp falls just behind it on the next sheet of paper to prevent its travel until the first sheet is clear. As the sheet in motion passes under the discs two combing fingers give it further propulsion on to the feeding takes. If it happen that no sheet is fed there are two spring rods which fall on an electric connection and stop the machine. At this point is a calliper gauge which will allow only one sheet to pass. Should two sheets pass down, the calliper is forced open and makes an electric trip. After passing forward to the impression cylinder front lays, there are two spring rods to trip the machine; there are also two larger curved spring



Cross Feeder. Cross Paper Feeder Co., Ltd.

trips to prevent a crumpled sheet proceeding and they also stop the machine.

The front lays and side register gauges can be accurately adjusted for any size sheet or number of printings in colour, such as can be seen in the thirteenth or fourteenth colour work on cigarette stiffeners.

The continuity of feeding is maintained by constantly lifting the paper on to the upper board, and the machine is never stopped while the feeder is being loaded, hence the term "continuous."

All parts of the feeders are standardized and readily replaceable from London stock. The apparatus is driven by the printing machine without any increase in h.p., as the feeder does not require more than one-tenth h.p. The speed of feeding depends on the capacity of the printing machine, and is usually regulated to suit the character of the paper. The feeder will work with all kinds of paper, from Bible paper up to cards .015 in. thick; it has been used successfully for cards .025 in. thick.

The feature of this feeder is that it manipulates sheets from 35 × 23 in. up to sheets 70 × 46 in., and it is contended by the makers that it is the most suitable feeder for the largest sizes of paper, especially for long runs.

The first Cross Feeder was installed in Great Britain—in London in fact—in July, 1906. Two years later the engineering works in England, at Walthamstow, commenced manufacturing. There have been 1,000 feeders erected in Great Britain and Ireland—one firm has 140, whilst 30, 40 and even 60 have been installed in various individual firms. In America over 7,000 are at work.

This feeder has been attached to all makes and sizes of letterpress machines, direct and offset rotary lithographic machines and folders.

The Cross Feeder is handled by the Cross Paper Feeder Co., Ltd., 96 Fleet Street, London, E.C.

AUTOMATIC FEEDERS OF THE H.T.B., LTD.

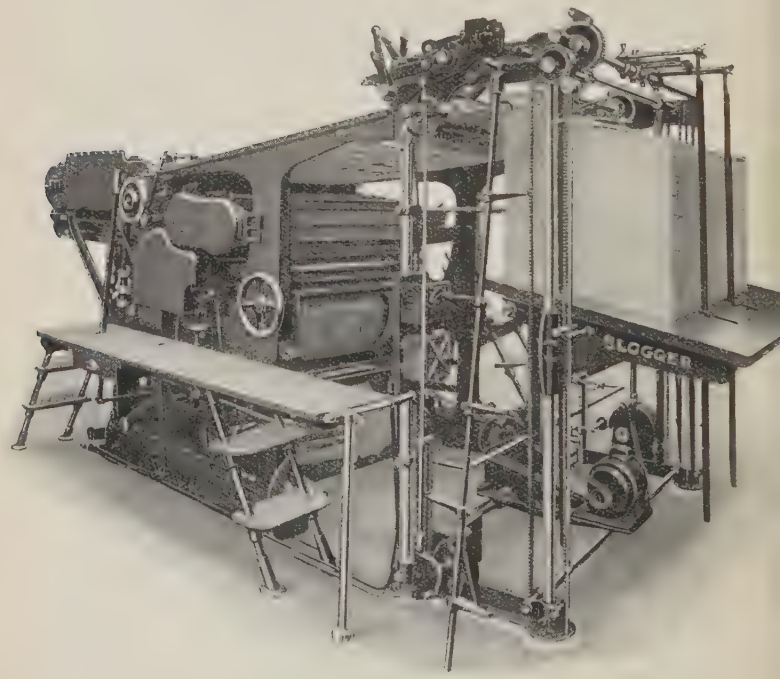
Messrs. H.T.B., Ltd., who make various types of sheet feeding machines, have a range of models suitable for all types of presses and all classes of work.

Broadly speaking, this firm's machines can be grouped into

three types, i.e., the full automatic feeder, the semi-automatic feeder and the pile hoist.

The three machines are briefly described below.

The Fully Automatic Feeder is a pile feeder and the pile capacity is controlled by the type of press the feeder is attached to. For instance, if the feeder is fitted to a Wharfedale, the pile will be about 3 ft. 6 in. high, whereas if the feeder is attached to a Miehle the pile will be about 6 ft. 0 in. Interchangeable pile boards are used so that the empty board is being stacked whilst one is in the feeder.



"Slogger" Pile Feeder on Rotary Offset Machine.
H.T.B., Ltd.

When the one in the feeder is empty, this can be lowered and the new stack trucked in, in about two minutes, so that no loss of printing time occurs between loads.

The separation is accomplished by a blast of air blowing along the edge of the sheet in exactly the same manner a reader opens the pages of a book by blowing on them.

A long metal duct or box with a narrow opening along its full length sprays a current of air on the front edge of the sheet and lifts the top one from its fellows.

Two rubber tipped fingers hold each front corner of the sheet to prevent it being blown away.

When the sheet is thoroughly separated, the air blast is cut off, the rubber coated fingers that are holding the sheet are lifted and two more rubber tipped fingers or strokers, as they are called, gently stroke off the top sheet from the pile and transfer it to conveying rollers.

All these operations are automatic and are performed by cams and the sequence of actions is so simple that the machine will feed quite large sheets at 5,000 per hour.

A full automatic feeder is only suitable for long runs, because the setting time necessary when changing jobs would make it unprofitable to work on short runs.

The percentage of printers whose work is composed of long runs is very small, but all the other printers whose work is of a short or medium run variety still require a feeder of some description which will, on these short runs, give improved register and increased output without the complications of a full automatic feeder.

It was for this purpose the H.T.B. Patent Semi-Automatic Feeder was introduced to the market in 1925, and it has been found to give, in addition to handling short runs profitably, equally satisfactory results on very long runs, which were thought previously to be only suitable for full automatics.

Broadly speaking, this machine is an automatic feeder in which the separation of sheets is accomplished by hand.

The semi-automatic, like the full automatic feeder, can be attached to any make of letterpress, direct litho., offset or folding machine.

The semi-automatic feeder, when attached to a press, has its own layboard for the conveyance of the sheets to the front marks. At the end of this layboard provision is made for a pile, from which the layer-on feeds.

The machine is made in two types, one with a small pile capacity of approximately two feet and the other with a pile to the floor. This latter is to enable pile boards interchangeable with the press pile delivery to be used. Transporter trucks can then be used for loading the feeder without the necessity for handling the stock.

The pile raising mechanism is so arrayed that the pile is practically continuous. Four endless chains are arranged, one at each corner of the board, and these chains are continuously but very slowly moving. The inside of the chain, of course, rises and the outside falls, and the rate of movement can be controlled to suit different thicknesses of stock.

At intervals along this chain are projecting pins, the pins being so placed on the chains that at any given time, all four pins, one on each chain, will be exactly level.

Two light girders, light enough to be handled with ease, are then placed on these pins, one joining the two front chains and the other joining the two back chains. Both girders then form the base or sling for the pile board. This pile board, which is made in sections for ease of handling, is placed on the girders and the pile is then stacked on top to the desired height.

When this pile is nearly fed away two more girders are placed on pins in the chain further down and a fresh pile is stacked up almost to the under side of the first board.

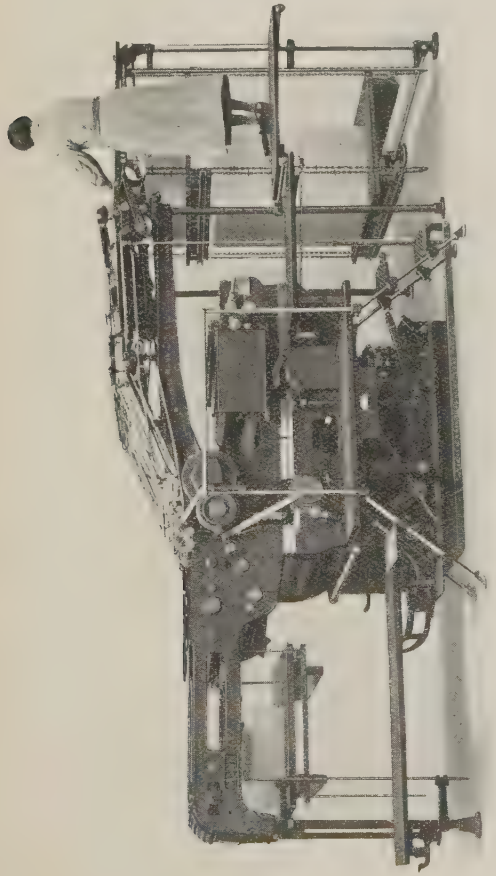
When the first pile is finished, the empty pile board is quickly removed together with its two girders and a fresh pile is exposed underneath ready for immediate use.

The principle of the full pile machine is exactly the same except that the second pile is trucked in on a transporter and dropped on the floor before the irons are attached to the chains.

Having, therefore, a pile to feed from, the layer-on can feed continuously without the stops otherwise necessary for putting up half-reams of paper at a time.

The semi-automatic feeder is provided with front lays and a side lay to which the layer-on feeds the sheet, but in this case the layer-on need not be accurate in the laying of the sheet. If the sheet is laid within $\frac{1}{4}$ in. of the front lays, the machine will register it to a hairline. If the layer-on exceeds this $\frac{1}{4}$ in. the feeder does not take the sheet, so it is impossible for a sheet to get down the layboard more than a given amount out of square.

The sheets are conveyed to the front lays of the press on endless tapes. These tapes are very smooth and are made endless in manufacture, there being no join. This is a feature which contributes largely to the extreme accuracy



H.T.B. Semi-Automatic Feeder on Mann Offset.
H.T.B., Ltd.

of register obtained with this feeder. When the sheet is registered and waiting for the grippers to take it, the slightest touch will ruin the register. If there are any sewn joints or metal fasteners in the tapes, these will keep touching the back edge of the sheet when the sheet should be perfectly still.

The tapes are driven by a special gear which slows down to a fraction of the original speed once in a revolution, so that although the sheet leaves the layer-on at a very high speed, it comes almost to a stand-still just as it arrives at the front lays of the press. This makes it possible to put through sheets twelve and fourteen times in perfect register, because the front edge is in no way damaged by collision with the press front lays.

When the sheet is registered at the front lays, a mechanical sidelay, with a delicate touch, draws the sheet to the side mark just before the grippers take.

If the layer-on misses a sheet, or pauses in feeding, the machine automatically trips the cylinder.

Feeding from a pile and with the need for accuracy gone, the layer-on can feed faster and the job is not so tedious as before. At the same time by getting continuous running the machine minder is able to keep his colour more even, and has peace of mind because he knows his register is constantly accurate.

The third machine Messrs. H.T.B. Ltd. make is a plain pile hoist for use with folding machines.

This pile hoist is on the same continuous chain design as the feeders, but has no feeding arrangement, merely taking the place of the feed board on the folder.

With the average present-day folder a speed of 3,000 or 4,000 can be obtained, but when only about half a ream at a time is put on the layboard a stop is necessary to replenish this about every five or six minutes. By the use of the pile hoist a continuous pile, automatically rising, allows the full output to be obtained by eliminating the stops for replenishing stock.

CHAPTER XXI.

THE WORKING OF OFFSET ROTARIES.

THE BLANKET.

The blanket is the feature of this method, which places it outside the ordinary process of printing direct either in flat-bed or rotary machines. The blanket is carried by a separate cylinder, known variously as the rubber cylinder, the transfer cylinder, or the offset cylinder. The blanket is a fine rubber composition upon canvas, and may be 2, 3 or 4-ply. It is an expensive item, and it becomes a matter for consideration whether it is more economical to use two 2-ply blankets instead of one 4-ply, because when damaged a blanket must be replaced. The chances of injury are not numerous, but they exist, and the life of a blanket is not very great when the machine is in constant use. It is possible that in cleaning the blanket a little extra scraping to remove some hardened ink may result in a cut or in pulling a small piece out. This may be repaired by cleaning out the hole with a pencil of corundum, then preparing it with solution of Para rubber in benzole. While this is still adhesive a piece of thin rubber film should be pressed into the hole and well up to the edges. This film should be large enough to overlap the hole. When dry the surplus rubber should be shaved off and the whole repair rubbed well with talc. Washing the blanket calls for special care, because the use of turpentine is so general in lithography. Turpentine is a solvent of rubber and should not be used for rubber blankets, as it gradually dissolves the surface and destroys it. The blanket must be cleaned with petroleum (popularly called paraffin); the residue of petroleum being washed off with soapy water, when it should be dried and dusted with sulphur, talc or magnesia.

In ordinary, everyday use, a rubber blanket may last two to three months; in some cases it has been worn out with a run of 200 reams. Its life depends to a large extent upon the rough or smooth character of the paper and the printing plate, as well as the additions made to the ink or damping

water to secure good printing. These latter additions should be avoided as much as possible.

The blanket must be kept in such a tension that it will not creep by its own elasticity and give slurred impressions. It further requires tightening up carefully to avoid any diagonal strains across its substance.

In working the machine everything depends on the blanket; it must run perfectly true and just sufficiently in contact with the plate cylinder to pick up a clear impression. The nature of the blanket being non-absorbent, it is limited in the amount of ink it will pick up. It is this characteristic which has so far limited its use in printing a bronzing ink sufficiently full to take the necessary quantity of bronze powder. The same feature of the rubber has brought about an improvement in printing inks; they are better ground and contain a much larger proportion of pigment to vehicle than ordinary direct printing requires. This necessitates an increase in the price of the inks, which is more than counterbalanced by the fact that offset printing requires only about one half the quantity of ink required for direct printing.

A point which arises with the use of the blanket is the possibility of executing work with a bronze printing. It has already been stated that the actual bronzing ink cannot be printed full enough, but it is also a drawback that even if the bronze has been printed on another machine, when the sheets are passed through the offset rotary the bronze powder is liable to accumulate on the rubber blanket and upon the metal printing plate. Whenever work of such character must be done in the offset rotary, the difficulties may be overcome by having the bronze sheets dusted thoroughly a second time before going into the offset machine. Whilst running off the order the blanket and printing plate must be occasionally thoroughly cleaned. The most successful way of executing work with a bronze in it is to print the bronze ink last of all upon a direct printing machine.

Lastly, the blanket receives an impression from the plate in a reversed lateral aspect, so that upon the plate the work appears in its ordinary or correct reading position, just as it is printed on the paper. To secure this, all work already drawn upon stone or metal plate, or engraved upon copper or steel plate in position for direct printing, requires to be reversed for the printing plate of the offset rotary.

RUBBER OFFSET BLANKETING.
(Contributed by Mr. W. R. Nicholson).

The advent of the rotary offset press immediately created a demand for rubber blanketing of first-class quality. The engineers were making great strides in the manufacture of the presses, which are as a rule built with great accuracy, and it was, therefore, essential that the blankets should also be accurate and depended upon to be of even thickness throughout with, say, only a maximum variation of not more than two-thousandths of an inch.

With rubber this is an exceedingly fine margin to work to when one considers the various processes it goes through before being finally turned out as an offset blanket. The fabrics two, three, four and even five-ply are first of all solutioned together, then the surface is spread, not in one operation, but built up gradually by very thin films of plastic rubber, necessitating running through the spreading machine dozens of times until the correct thickness has been attained.

The blanketing is now in a semi-vulcanized condition and has to go through the final process of curing. This process has to be watched most carefully, because upon the result depends whether the blanket turns out in good condition. A few minutes too long in curing causes the blanket to be too hard and very liable to crack or perish. On the other hand, if not sufficiently cured it will be soft and when in use become tacky with also the possibility of embossing.

The term plastic rubber does not mean pure rubber, which would be useless for the purpose, but as in most rubber goods, a mixture of other chemicals, etc., evolved by very clever chemists who have to take into account that the blankets are intended to come into contact with and be able to resist greasy ink—grease, as is generally known, being an enemy to rubber. Rarely have two manufacturers the same mixture, hence the variation in price, quality and service of blankets. A cheap mixture is most unreliable and may prove very expensive to the user in the long run.

British made printers' blanketing has all along held, and still continues to hold, a foremost position throughout the world, although American manufacturers are striving hard to make something as good. The success of the first offset

press in the U.S.A. was in no small measure due to the use of British blankets, and until recent times they were almost solely used in the production of offset work over there.

The thickness adopted by practically all the American press manufacturers is .065 in. of 3-ply fabrics with only one blanket on the offset cylinder, whereas the British and Continental press manufacturers in most cases use .075 in. of 4-ply fabrics, the "Nixo" quality offset blanketing with the fine backing being the original of this style, and, excepting in the U.S.A., is universally used. Many of the leading press manufacturers on this side of the Atlantic have designed their machines to accommodate two .075 in. blankets on the offset cylinder. This gives greater resiliency and in the long run is more economical, as the single blankets have to be discarded very much more frequently as compared to the system of using two blankets. As an instance, should a sheet of paper happen to double on the corner when going through the machine it has generally no ill effect on the top blanket when two are used, but should this happen when only one blanket is being used it is often ruined and unfit for further service.

Grey and red blankets are practically the only colours in general use, the grey being mostly favoured on account of its toughness and longer service. The only advantage in red blankets is that they have a finer surface as compared to grey, owing to the different ingredients used in the mixture, but they need very careful treatment in use, as they are very liable to blister and being more elastic are inclined to stretch.

In cleaning offset blankets, benzine or petrol, which are rubber solvents, should not be used. This does not mean that they dissolve the rubber, but on the contrary cause it to swell. This swelling takes all the nature out of it, and will also loosen the rubber from the fabrics. Ordinary kerosene is not so severe and failing a good rubber wash, this is probably the best and handiest wash to use. It is, however, preferable to first of all damp all over the blanket with water, which protects the part clear of the job, yet leaving exposed the ink which needs to be cleaned off. To remove any surplus moisture remaining on the blanket dust over with a mixture of, say, three parts of magnesia to one of powdered sulphur.

INKING.

The inking apparatus of the offset rotary is so arranged that it gives a fine even flow of well-distributed ink. A feature of the early direct rotary machines was to have a certain number of rubber rollers with the nap rollers. It has been found by experience that rubber rollers have a tendency to squeeze the water along the plate, where it meets the nap rollers and mixes with the ink, causing it to print very barely. Even if rubber rollers were useful in the direct rotary to roll the ink even after it had been put on by the nap rollers, or to make it even by stripping a little off, this is entirely unnecessary in the offset rotary, where the rubber blanket picks up so little from the plate. Rubber rollers have a further disadvantage that they do not ink up a plate as thoroughly as nap rollers. It is apparent, therefore, that rubber rollers should be abandoned and nap rollers only should be used. The working of the ordinary hard glazed rollers is not advantageous, as they fail to sink into the grain of the plate and ink the work properly. Rollers which have been broken in by the hard varnish method are both suitable and successful for colour work.

The advent of offset printing brought about investigation as to the improvement of inking rollers. Possibly it may have been thought that as the rubber blanket is capable of picking up the ink from the plate, that conversely a firm, but resilient roller would be equally capable of carrying the ink to the plate. Whatever may have been the underlying principle, the result took shape in the "Ideal" roller being made for offset printing, and it is gradually being adopted by leading lithographic printers.

As this roller is of a different manufacture to most of the usual offset and letterpress rollers, the description of its manufacture may be briefly described.

The roller mould is heated in an oven, to the necessary temperature for melting wax. The mould is mounted horizontally between two clutches which can be rotated rapidly by power. Through the mould a spindle is mounted centrally. While in rotation wax is introduced, which quickly spreads to form an even coating. Following this an oil is fed in through a funnel receiver over one end of the spindle, and on resuming the rotation this oil, which is now vulcanized, is spread evenly over the wax coating.

A similar process is carried out in another cylinder, without the central spindle.

The latter is then set upright in the stand used for vertical spindles, and the coated spindle already made is put in the centre of the coated cylinder. When fixed a composition known as the filler or cushion is poured in, thus completing the roller in its first or rough state. In this rough state it is placed vertically in a mechanical appliance fitted with gas jets from top to bottom. The heat quickly melts the wax and leaves the roller ready for turning up in the lathe. The adjustments of the lathe are controlled by micrometer gauges to secure perfect diameter and smoothness of face. The rollers need little or no time for maturing, so they may in fact be transported at once from the lathe to the printing press.

It is claimed by the manufacturers, Messrs. Ault and Wiborg, that the "Ideal" roller is not affected by conditions of climate.

One set can be used for all colours and do not require re-setting after a change of colour.

No colour will penetrate them.

"Ideal" rollers have made "dry lithography" possible.

Cleaning up is reduced over one half the usual time of nap rollers.

The British factory for these rollers and printing inks is in Standen Road, Southfields, London, S.W. The original factory is in U.S.A., and a further factory is in Germany. Rollers have been supplied to India, where they are used successfully. British firms who have used them are quite satisfied; and in the specifications of the Marinoni-Voirin machines it is stated that they supply "Ideal" rollers with their offset machines.

The first production of the "Ideal" roller was in 1911, and it was patented.

LITHO. MACHINE ROLLERS.

(Contributed by Messrs. Horsell & Co., Ltd.)

The litho. printer need not be told that it does not pay to work with imperfect rollers, and it is vital for the production of perfect work that this part of the machine should receive his careful attention and the rollers should be repacked and skins renewed as become necessary, to keep them in perfect order.

Messrs. Frank Horsell & Co., Ltd., of Leeds, are litho. roller experts of forty years' standing and large experience, and their name is synonymous with reliability, quality, and sound workmanship in relation to litho. rollers.

They are the largest makers of litho. roller skins in the United Kingdom, and their skins and patent seamless roller packing are used by most of the leading machine makers. They use only the best selected French hides, each skin being subjected to the most critical examination and selection before being sent out and they are guaranteed to be perfectly level and even throughout. Their patent seamless roller packing is now so well known as to require little description except to state that these covers are woven and not knitted, being manufactured from specially prepared and selected yarns. This ensures a thoroughly reliable and long wearing material. Its advantages over sewn-on flannels are manifold and may be briefly described as follows:—

No lumps or "matting" as with felt and flannel.

Regular supply of moisture when used for dampers.

Easily cleaned. No stitches to risk cutting into.

No stitches to cut away by scraping clean—will wear through.

Can be fastened on immediately by tying ends.

No seams, consequently no uneven or "lumpy" rollers. Keeps surface in perfect order.

No waste of material—exact length required being cut off. No waste of time in cutting out, fitting, sewing on flannels, etc.

Economy in stock. Six widths are about equal to thick flannel, 52 in. wide.

All these seamless covers are woven, not knitted.

Duplicate rollers unnecessary. Rollers can be packed in a few minutes.

Will last three times as long as ordinary flannels or felts—must be worn through.

Material specially manufactured for this purpose only, and made to suit all requirements.

Unequal stretching of skins prevented.

Saves stitches breaking out, skins thus wearing much longer.

Packing remains soft much longer, owing to superior quality of woollen and other yarns used.

Made in sizes to fit one over the over and are drawn on the rollers in the same manner as leather skins.

The use of these materials will effect a considerable saving in time alone, and the result is a far more satisfactory roller with infinitely better results. Messrs. Horsell also manufacture a patent seamless tubular rubber skin which they supply very largely and particularly recommend for offset and rotary machines, transferring, photo-litho., etc. These are mounted on the rollers over their patent seamless woollen covers, in exactly the same way as leather skins, and being entirely seamless they produce a perfectly even roller without any suspicion of lumpiness. They also pay special attention to the manufacture of litho. hand rollers, the blocks of which are made from selected seasoned British beech, the blocks and handles being all in one piece. The skins for these are also most carefully selected and can also be supplied with the tubular rubber skins above referred to, if required.

This reference to litho. rollers would not be complete without mentioning Messrs. Horsell's Patent Litho. Roller Covering Machine, which is used by the leading lithographers in this country and has also been sold very largely for export.

By its use litho. rollers can be stripped and recovered in from two to five minutes. This machine will cover any size of roller up to 67 in. long, and Messrs. Horsell claim that rollers covered by the same and with their patent seamless packing will last five times longer than when covered by hand. Baggy skins can be tightened without injury in a few minutes.

Messrs. Horsell offer the following words of advice on this subject to the litho. printer:—

The best method is to keep several sets of rollers to each machine, so as to have a set for each of the different colours and so save time in washing up; where this is possible full nap rollers can be used and are prepared as follows:—

Rub tallow or castor oil into the skins, allow to soak in and repeat until charged.

Then put them into the machine and pull out with a mixture of mid and strong varnish, so as to draw any loose nap from the surface; afterwards wash out with turpentine.

Where only one set of rollers is available, it is necessary to prepare them in such a way that they can be washed up for a change of colour with a minimum of labour. These

are best prepared as follows :—Mix equal quantities of thin varnish and Seccatine driers and work this well into the skin ; allow to dry, and repeat this treatment. Place them in the machine and run them up with a mixture of mid and strong varnish, and then wash out with turpentine, as before. The driers will prevent the ink or turps penetrating the skin, and a change of colour is easily effected.

Note.—Always scrape leather rollers with a blunt knife, and scrape in the direction of the nap.

For black rollers, roll up in good black ink and keep the surface moist.

For glazed or smooth rollers only a very thin coating of elastic glaze should be used—just sufficient to fill up the pores of the leather. Great care must be taken not to allow the ink or glaze to cake upon the surface.

We advise that all rollers should periodically be given a thorough rubbing with tallow or castor oil, so as to keep them in good working condition.

Additional cover should be put on rollers when new skins stretch after being in work a short time, or the skins carefully and evenly stretched down by hand or machine.

As leather rollers are in common use and are not likely to be displaced for many years the following notes upon rollers, as made by Schmautz, of Paris, are interesting :—

The skins are re-selected from the finest calf skins obtainable, a large proportion having been rejected, as even the finest skins have rarely escaped the stings of insects, and in every such case that particular spot has become calloused or hard, and of a different character to the remainder of the skin, which has its own special flexibility. Spots such as these are avoided in cutting the skins. Each skin is mechanically treated to obtain evenness of thickness throughout. The seam is almost imperceptible to sight or touch. The packings are of the highest quality and perfect fitting. The skin is drawn on by a very ingenious machine—probably the only one of its construction. The completed roller is subjected to another machine to secure its true cylindrical form. Finally, it is run for days on a special machine to prepare it for the printer.

Messrs. McKinley & Co., Cincinnati, make an improved form of graining machine, as previously described and another

item is a distributing roller of special construction, patented in 1901, 1906, and 1912. It consists of a steel shaft with bearings and aluminium tubings, dia. $3\frac{1}{4}$ in. For use with stones, it is all steel and of $2\frac{1}{2}$ in. diameter. The oscillation is effected by a two-way worm on the shaft, with automatic drop levers to reverse the motion. The full extent of oscillation may be regulated up to 7 in. The special features of even distribution and hastening evaporation of moisture have been appreciated in America, where 90 per cent. of the lithographic houses have used them. The makers claim that it eliminates 75 per cent. of the water troubles, on rotary and flat-bed machines.

DAMPING.

The damping in offset rotaries presents no new difficulties to those experienced in direct rotaries, and already dealt with in Chapter XII. The damping rollers should be of the newer type, with some amount of rubber under the cover to assist in retaining their cylindrical form. In some of the present offset rotaries the adjustment of water supply can be regulated to one-half tooth of the ratchet, and in ordinary practice one to two teeth give ample damping.

REVERSING TRANSFERS.

As so much original work exists upon stone, zinc and aluminium plates, and engraved upon copper and steel plates, in most printing firms, such work requires to be reversed laterally to suit the offset printing method. The reversing must be of the best quality. The old method of reversing commonly practised by lithographic printers is applicable for this purpose. Other methods have been introduced recently, more or less specially useful. Of such methods one has recommendations of economy and speed for the more simple and bold work.

This method is to take a transfer from the original direct upon a very thin zinc plate. The gauge of the plate should be B.W.G. 34 to 36, and now sold as "wafer plate." When the transfer has been pulled it is then treated as a transfer upon zinc (Chapters VI and VII), and becomes an original from which any number of transfers may be pulled upon transfer paper ready to be put down on the printing plate for the offset rotary. Providing that the work is fairly bold, the method

gives good results. If the work be fine there is a great possibility that many lines will be broken by the grain of the zinc plate. This difficulty may be largely overcome by using a zinc plate very finely grained and a firm elastic backing when pulling the transfer upon the zinc.

The well-known method of taking a transfer from the original on stone or metal, and placing it upon fine, Ever-damp transfer paper, then pulling it through, gives excellent results, and notwithstanding that this takes longer when many transfers are required than the zinc plate method, its good quality may be sufficient to give it preference.

A method of pulling a transfer upon rubber blanket and taking one from it upon Ever-damp paper, has theoretically some recommendation. This method involves the necessity of cleaning the rubber after each transfer, causing loss of time and material. Further, the elasticity of even so thin a layer of rubber is sufficient to cause it to creep, when run through under the scraper. This might be overcome by running such transfers through in a press like the Wogdon Short-run Litho. Press, where the pressure is exerted by a cylinder.

It may be possible to use a very thin film of rubber mounted on a rigid support to prevent the creeping, and to hinge it in a press to prevent the necessity for cleaning after each impression.

Transfers from copper or steel plates can be reversed in the ordinary way with Ever-damp transfer paper.

Transfers from half-tone blocks are amenable to the same method; the transfer from the block being taken with every precaution, as previously stated.

The need for reversed work in offset rotary printing has created a demand for the alteration of business methods. Lithographic draughtsmen now draw work in its correct way; photographers produce negatives suitable for direct work on zinc or aluminium; and process engravers make intaglio copperplate etchings from which lithographic printers can take transfers in the proper position.

There are times when good negatives must not be tampered with, when they are not reversed for printing purposes. Such a negative may be used to obtain a fine grained collotype printing plate, which would, however, give reversed or incorrect prints. In this case, by using a thin sheet of aluminium, finely grained, a direct transfer may be taken from

the collotype surface as set forth in Patent 4,345, 1904, from which good transfers or prints may be obtained in the correct position.

In the use of tinplate printing machines, either for actual tinplate printing, or for lithography upon rough and common boards or paper, or in the use of the offset rotary machine, it is necessary to have the design correctly disposed right and left on the plate on the printing cylinder.

B. WINSTONE AND SONS' BRITISH-MADE VICTORY EVER-DAMP TRANSFER PAPER.

Made in royal size at 10s. per quire, it is a light coloured paper with all the most desirable properties of the perfect Ever-damp transfer paper.

Transfers pulled upon it will remain fresh for an almost indefinite period, while the finest copperplate engraving and heaviest solid alike may be reversed or transferred satisfactorily.

WINSTONE'S METHOD.

In transferring engravings for the lithographic offset press, some difficulty is occasionally experienced in obtaining satisfactory results in the reversing process.

Many methods have been tried and several have been found altogether useless for commercial purposes, although a method that will answer well in one establishment will not apply equally well when used for a different class of work in another.

In the following instructions we have given four processes which are being used successfully in Great Britain and on the Continent.

1. A transfer from a copperplate is made with Winstone's Hard Transfer Ink upon No. 4 transfer paper; this is laid face up on a thin sheet of zinc, then a piece of No. 7 transfer paper is placed upon it with the composition side next to the transfer, and after placing another sheet of zinc on the top the whole is pulled through the copperplate press once, with very heavy pressure. (The services of several men are sometimes required to turn the press for this method.) A little warmth is occasionally required to separate the transfers thus obtained.

2. A transfer pulled with Winstone's Soft Plate Transfer Ink is laid face up on a warm litho. stone. Upon this is placed a piece of No. 4 transfer paper which has previously been damped slightly in the usual manner (face to face). Placing two or three sheets of printing paper on top, the whole is pulled through the transfer press several times with heavy pressure. A little heat is required for separating the transfers.
3. The third method is perhaps the most successful of all. Copperplate transfers are first transferred to the litho. stone in the usual way. After touching up the solids and cleaning up thoroughly, a re-transfer is taken upon Winstone's No. 8 Ever-damp Transfer Paper. A clean sheet of the same paper is then placed upon the transfer—i.e., face to face—and the two sheets are pulled through the transfer press two or three times with medium pressure. To assist the separation a strip of thin plain paper should be laid along the edge between the two sheets before applying the pressure. When separated it will be found that the reversed transfer is in every way equal to the impression from the original.

   The extra time taken up by transferring to stone before reversing is more than compensated by the saving of time in patching and touching up the solids and cleaning up of one transfer instead of doing so with several on the machine plate.

   The Ever-damp Transfer Paper No. 8, as used in this method, differs considerably from every other transfer paper of its kind at present on the market. It has important features possessed by no other, and it will either transfer in the ordinary way or make reverses of the finest possible work without losing anything of the beauty of the original in the transferring process.
4. Reversed transfers from type are quickly and easily made by the letterpress printer. An impression of the type matter is made upon a sheet of well-calendered paper that has been fastened in position on either the platen or cylinder. The print must be "full-bodied" and "sharp." The ink used is Winstone's ordinary stone to stone re-transfer ink. A sheet of No. 8 Ever-damp Transfer Paper is then fed into the machine,

so that the coated side will come in contact with the print that has been made upon either the cylinder or platen. The second impression is now made upon the back of the transfer paper with or without ink, which causes the ink from the previously printed sheet to set off on to the face of the transfer paper, thus giving the reversed type transfer.

With these four methods to select from, any lithographer with a little practice can, without costly experiments, obtain most satisfactory results.

REVERSING AND PROVING PRESSES.

As offset printing requires that all work on the printing plate should appear in the normal reading position (i.e., left to right), it has become necessary to find a ready means of reversing, from right to left.

All the originals—of which there are many thousands—already existing on lithographic stones, zinc and aluminium plates and engraved stones, copper and steel plates and photo-process productions have to be reversed for offset printing. The same necessity exists for reversing type matter, unless the normal type made some years ago be used.

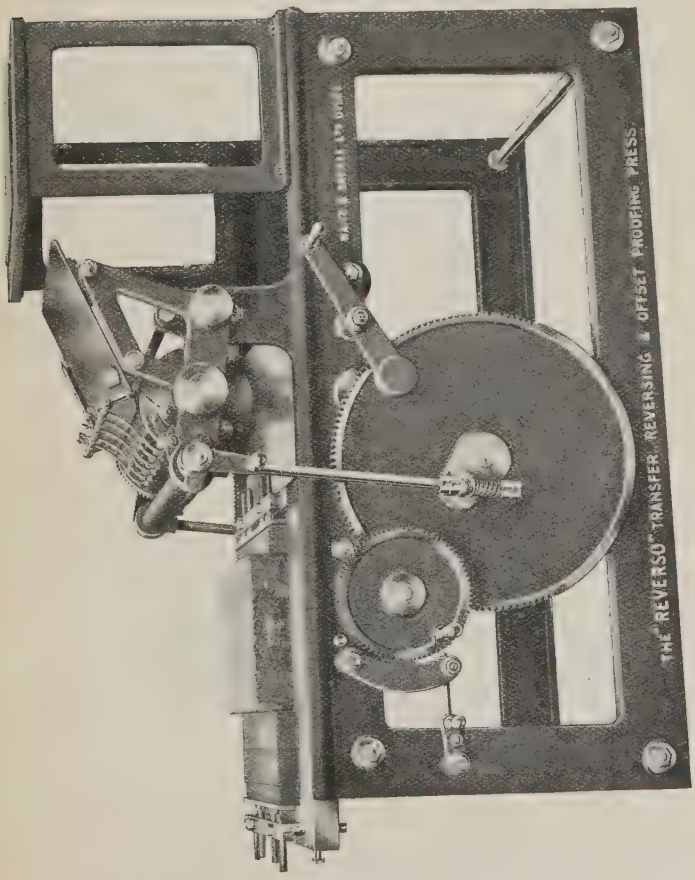
For both reversing and for proving offset several firms have constructed presses. Some only for reversing, others for both operations. The following are some leading examples :

THE WAITE "REVERSO."

It will be seen from the illustration that the bed of the machine travels to and fro, carrying the stone or other original under the impression cylinder. The cylinder has grippers for feeding for reversing or for proving. The bed is adjustable to take originals from the depth of type formes to stones 4 in. thick. It is made in two sizes, medium and double crown. The original has to be rolled up by hand roller, and the travel of the bed is by hand power.

R. W. CRABTREE AND SONS' REVERSING AND PROVING PRESS.

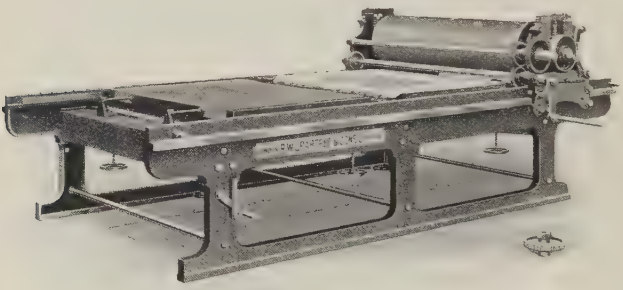
The press made by Messrs. Crabtree is as nearly as possible a "printing machine" of the same construction as the patent "Wogdon." The whole impression cylinder travels over the



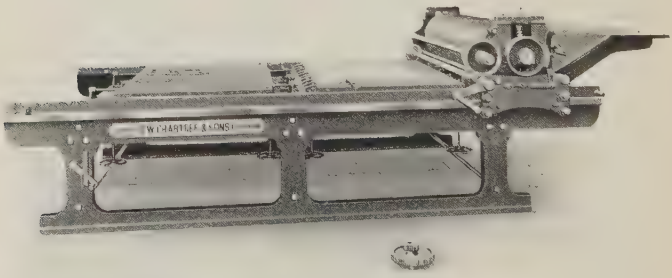
"Reverso" Offset Proving and Reversing Press. Waite & Saville, Ltd.

reversing surface and the original (to be reversed). Further, a feed board may be attached as in the illustration.

It can be used for making reversed transfers, for proving



Proving, Reversing and Transfer Press.
Showing Plates and Front Clamps for Duplicating.



Showing Plate and Paper Grippers for Proving and Reversing.
R. W. Crabtree & Sons, Ltd.

offset and for taking ordinary transfers, and the craftsman may find other useful applications for it. In each case the original has to be rolled up by hand.

It is made in sizes from demy upwards, and is actuated by hand power.

R. W. CRABTREE AND SONS' LITHO. PRESS ATTACHMENT.

In this press an ingenious use is made of the ordinary lithographic press by a "Patent Offset Proving Platen," made in sizes from 18 × 27 in. upwards.

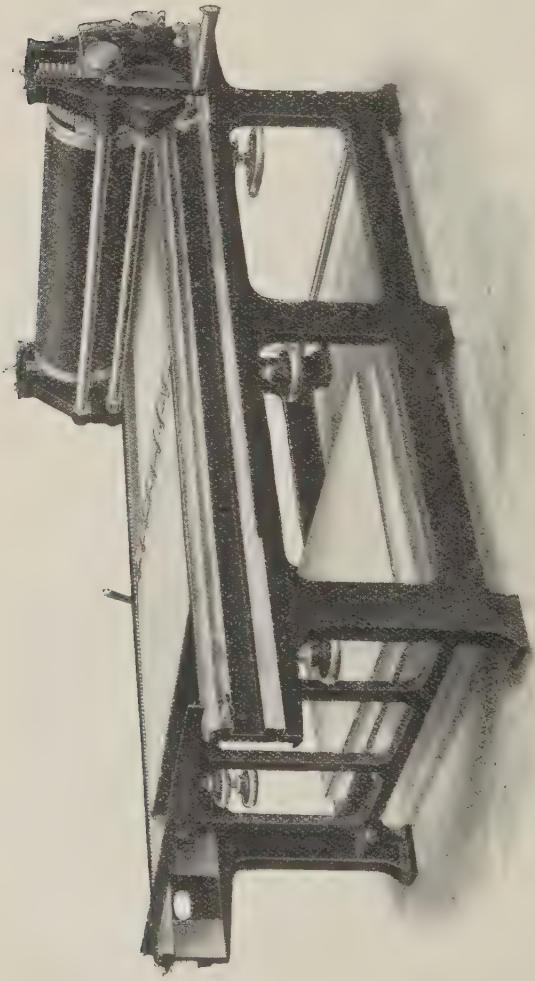
The platen consists of a tympan frame on which are stretched the zinc tympan and the rubber blanket. The blanket is under the zinc and face downwards to stone or plate. The tympan frame is hinged to the press carriage and a register gauge is fitted to the tail of the frame to secure register between the rubber blanket and the press carriage. This gives the means of obtaining transfers that will register. It should be added that the same purpose is further served by the zinc tympan which prevents the creep of the rubber when being pulled through. The original on the carriage is locked up by screws. The attachment can be supplied to fit on existing press carriages, and a special bed is made for type formes.

G. MANN AND CO.'S REVERSING AND PROVING PRESS.

This press is another and still closer resemblance to the patent "Wogdon" press. The illustration shows the construction, in which it will be seen that the head piece carrying the impression cylinder travels along the frame, over the transfer bed and original. The procedure is as follows:—The cylinder with its rubber blanket passes over the plate or stone to take the impression. The sheet is fed into the grippers of the impression surface or transfer bed, and the cylinder on its return passes over the sheet, thereby transferring the impression (in the positive) from the blanket to the sheet.

By suitable adjustment the press can be used for making reverses. The rolling up is done by hand roller, and the drive may be hand or motor.

It is made in demy folio, double crown, double demy, and quad crown. The demy folio occupies 7 ft. × 4 ft. 6 in., with a weight of 17 cwts., and the quad crown is 11 ft. 10 in. 6 ft. 6 in., with a weight of 2 tons 13 cwts.



Offset Proving and Reversing Press. George Mann & Co., Ltd.

MARINONI-VOIRIN OFFSET PROVING AND REVERSING PRESSES.

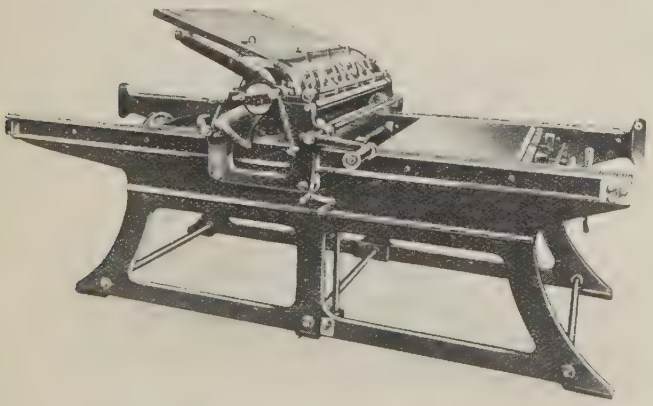
The presses built by this firm are of two types, viz., (1) the heavy type, and (2) the smaller lighter type.

THE HEAVY TYPE.

This press very closely resembles the first machines built on the principle of the patent "Wogdon" driven by hand power.

It consists of two beds rigidly supported in the frame. But each bed is capable of very fine levelling adjustment, so that each corner individually may be raised or lowered. The adjustments may be worked in pairs simultaneously for raising or lowering each side of the bed. The adjustments are effected by bevel gear and finely threaded vertical screws controlled by a wheel and winged nuts driven by hand.

The frame carries full length racks in which the impression cylinder head is driven by hand gear from end to end over the bed plates, one of which supports the original. The cylinder is covered with a rubber blanket, is provided with feed boards, hand operated grippers, and adjustable side lays.



Offset Proving and Reversing Press (Heavy Type).
Francis J. Connolly, Ltd.

The pressure is adjustable conveniently at each end of the machine, and the moving head is held to the side frames by projecting slides running under strong slides on each side frame.

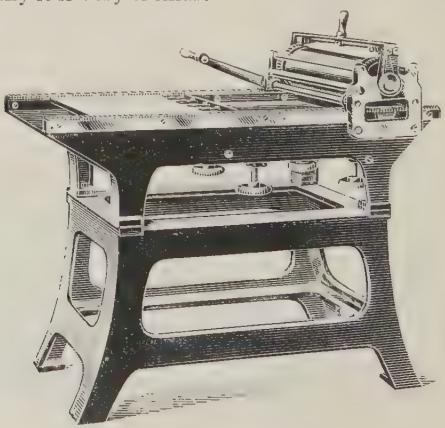
The press is capable of executing all forms of transfer making—direct or offset reverses—from stone, zinc or aluminium plates or type; and *pari passu* it can be used for printing on tin or brass plate, flat surfaces of china (in the "biscuit"), glass or wood, etc.

The cylinder normally makes two revolutions in its complete travel one way, but it can be arranged to miss the second revolution when required. It can be raised or lowered by hand gear at any part of its traverse; and when it is returned over the beds it is automatically raised out of contact with the beds.

It is made in two sizes, 30 × 20 in., and 45 × 35 in., and its weight is about 1 ton 15 cwts., and $2\frac{1}{4}$ tons respectively.

THE LIGHTER TYPE.

The second type of press is made in one size, $23\frac{1}{2} \times 18\frac{1}{2}$ in. Its working is quite different from the heavy press, although mechanically it is very similar.



Offset Proving and Reversing Press.
Francis J. Connolly, Ltd.

There are two beds, one of which, the impression or transfer bed, is fixed. On this bed are the grippers and adjustable lay gauges. In the centre of this bed are some small apertures into which are fixed very short needle points to project a mere fraction above the level, but not far enough to damage the cylinder rubber blankets. These needle points serve for register, by centring the sheet.

The other bed is adjustable. On it is fitted a hinged register frame having a gripper at the extreme end of the press. For proving colour work a sheet of card is fixed under the gripper and under the metal strips screwed on the upper side of the register frame. The first impression from the work is taken on the card, and then the print should be cut out leaving only the usual register marks, which will serve for placing the successive colour plates in the correct position for the following printings.

The same object can be attained by using two strips of celluloid across the frame, either set each way of the frame at the centre lines, or one strip only across where the register marks are on the printing surface. This is the method adopted in the Ogden multiple duplicating machine described in Chapter XVII, the frame being removable to facilitate the operation.

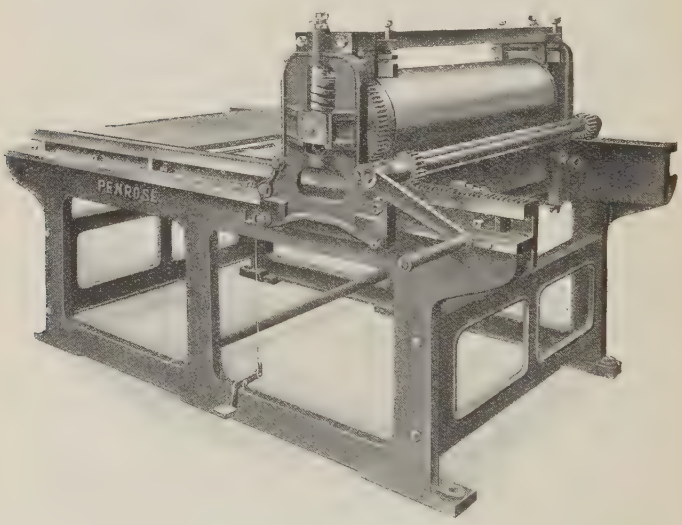
The cylinder is covered with two blankets, is mounted in a frame which is held in position by slides working under slides all along the side frames of the press. In the side frames are racks running the whole length, in which the cylinder head frame travels to and fro over the two beds. The cylinder bearings are eccentric and by them the cylinder can be raised or lowered into printing contact. This is effected by a bar across the top moved by a handle; the pressure is controlled by four screws under each bed.

The adjustable bed will take any originals, from type formes to stones, and the press can be used for making any kind of transfers, direct or offset, and reverses.

MESSRS. PENROSE'S "IMPERIAL" OFFSET PROOF PRESS.

In this press is another example of the whole impression cylinder head travelling along the frame over the reversing bed and original as in the patent "Wogdon." In this press the grippers are on the printing bed, which secure register.

These grippers can be released by a pedal for the laying-on to correct register. If desired, the printing bed may be enamelled white, so that an impression direct on it from one colour can be used for laying the paper for proving in other colours. Both the plate bed and the printing bed may be adjusted for different heights of printing surfaces, and to assist in removing such surfaces.



"Imperial" Offset and Reversing Press.
A. W. Penrose & Co., Ltd.

As it is designed for offset proving, it is *per se* equally applicable to making reverses. It can also be used for ordinary lithographic transfer pulling. As a side issue it may be used for transferring patterns on brass, or earthen tiles. It is made in sizes to take plates up to 26×37 in. and 44×40 in. The press is driven by hand power; a motor can be fitted to the larger press.

THE "WOGDON" PRESS (MACHINE) FOR REVERSING AND OFFSET PROVING.

This machine, invented and patented by Mr. J. W. Read, was described in my book "Transferring," in 1912, and its claims were set forth in the advertisement pages of that book. Those claims were made to my knowledge to be strictly accurate, and such claims are accurate to-day. It is more than surprising that a machine of such utility should have been overlooked by printers all these years.

In its early form it very much resembled the recent heavy type press of Messrs. Marinoni-Voirin, especially as it was hand driven. But when it was rebuilt for power its construction was greatly improved and it was the most inexpensive press and machine obtainable. I may mention that in the power driven press some of the special adjustments were made to my design.

The cylinder head is complete in itself, as in a flat-bed lithographic machine, with its full complement of inkers and dampers. The cylinder has the necessary grippers, and the delivery fliers are built on this movable head piece. The whole head travels on racks in the frame from end to end. It is held to the frame by slides working under slides on the side frames.

In operation the sheets are fed from a stationary feed board and paper table, with register gauges and front lays to the cylinder grippers. The moving head runs along the frame, the inkers charge the work, the sheet is printed and delivered as the inkers run over the ink table. At both the forward and backward travel the dampers perform their work and renew the moisture on the damping board. Everything is done as in ordinary machines at 500 to 650 runs per hour, and the machine has been used for all the purposes of the offset proving and reversing presses.

The special features of this machine-press are that in proving in colours there is no laying-on to register guides by hand, whilst the inking is done by a stack of rollers in the same manner as when the actual issue will be printed in the offset rotary machine.

"MAILANDER" PROVING AND REVERSING PRESS.

The German presses are on much the same line of construction as the foregoing examples. But J. G. Mailander,

of Cannstatt, one of the early makers of lithographic machines for both paper and tin printing, devised his first press, for proving tinplate work, about 1900–1; and more recently he built a press for reversing and proving for offset work. This press incorporates the principle of the "Wogdon" press in that the cylinder travels on side racks from end to end. There is a feed board with side and front lays, and the cylinder is provided with grippers. The printing surface and the impression bed are held rigidly in position, and a delivery board is at the end.

It is made in two sizes for printing surfaces of $23\frac{1}{2} \cdot 15$ in. and $31\frac{1}{2} \times 23\frac{1}{2}$ in.

FUCHS AND LANG MANUFACTURING CO., NEW YORK.
REVERSING AND PROVING PRESS.

This press has a cylinder which travels from end to end on racks. The blanket is fastened to detachable clamps, so that it may be turned from end to end, or readily removed for change of blankets.

It is arranged to suit both stones and plates. The plates are clamped flat, without bent edges. The impression bed has adjustable feed guides and paper grippers.

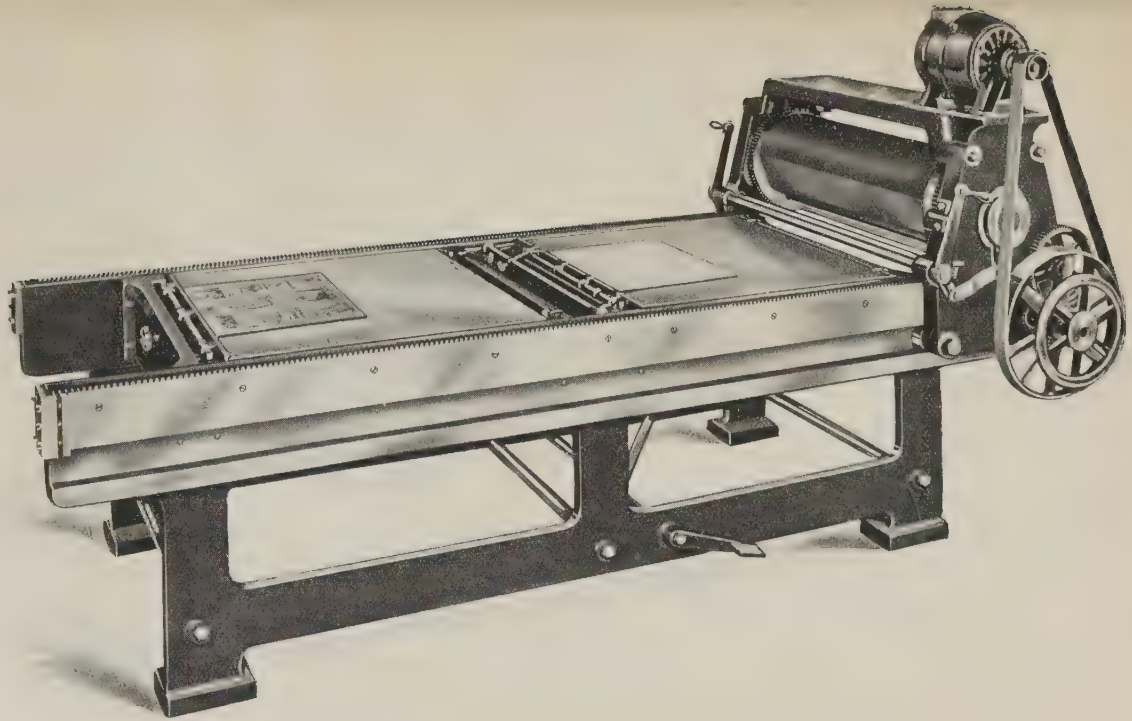
Besides being used for reversing transfers and proving offset work, it is in use for small editions of brass signs, name-plates, diplomas, bonds, clock dials, scale charts and radio panels.

It is made in two sizes:—For plates of 30×22 in., and 36×30 in.

A similar press is also made for driving by $1\frac{1}{2}$ h.p. motor.

CHARLES WAGNER, HOBOKEN. REVERSING AND PROVING PRESS.

This press is made in several patterns and sizes. The principle is that the cylinder travels on side racks from end to end. The plate is held by strong clamps, for rolling up by hand. The grippers are on the impression plate. The pressure is exerted by a lever at the top of the cylinder carriage, and is kept constant by side screws. In the large pattern the pressure is indicated on a dial, which serves as an index for securing similar pressure subsequently. In this



Rutherford Offset Colour Proving Press, with Positive Pressure.
The Fuchs & Lang Mfg. Co.

press stones may be used; and without putting in a bed-plate special clamps are there also to take plates. The stone is adjustable to height in the same manner employed in litho. machines.

The smaller presses for plates, 30 × 22 in., 36 × 32 in., and 44 × 34 in., are hand driven.

The presses for 28 × 22 in., 44 × 34 in. and 52 × 37 in. are motor driven; the largest size requires 1½ to 2 h.p. A small press for 16 × 12 in. plates can be placed on the transferrer's bench.

THE "CONCORDIA" OFFSET PROVING AND REVERSING PRESS. FABER AND SCHLEICHER, OF OFFENBACH.

This press is unique. It is simple in structure, and is "driven" by hand power. It has all the necessary adjustments for the plate and impression beds. The blanket-covered cylinder rolls along the press from end to end, in finely cut side racks. It contains cams which, when actuated by stops in its traverse, raise or lower the printing part of the cylinder at the correct moments, so that it is raised to pass over the impression surface on the outward traverse and lowered on the return after taking up the print, to give the offset print on paper or tinplate. From the axis of the cylinder there are projecting handles, by which the cylinder is easily pushed in both directions.

It is made in four sizes, to print 17½ × 24 in. up to 39 × 53 in. and it has the special recommendation that it is worked satisfactorily in England.

SPEED OF PRINTING.

The speed of printing here referred to is not the actual output of the machine, but the speed at which the cylinders rotate and pass over the printing surface. The output of the machine cannot be taken as a guide for the speed at which the surfaces travel; and as it is the impression itself which is the basis of all calculations of efficiency, the actual speed at which the impression cylinder brings the paper into contact with the printing surface is the one to be taken as the unit. Thus, in a double demy flat-bed machine the impression cylinder is 21 in. diameter, its circumference being 63 in. When the machine travels, the cylinder only rotates half the time of a complete traverse; therefore at a speed of 1,000

impressions per hour the cylinder rotates 1,000 times in half an hour. As it is 63 in. in circumference, it travels 63,000 inches in the half hour, or 126,000 in. or 10,500 ft. per hour. Comparing this with the Mann Offset Rotary, double demy, having an impression cylinder 11 in. diameter, or 33 in. circumference, which revolves twice in the ordinary traverse of the machine; when the speed of production is 2,000 copies per hour the cylinder travels 33 in. 2,000 times in half an hour, or 66,000 in. In an hour it travels 132,000 in., or at a rate of 11,000 ft.

Whilst the actual speed of travelling in the offset rotary is only increased by 500 ft. per hour, or $\frac{1}{22}$ of the speed of the flat-bed machine, the output is doubled. This points to the great economy of the offset rotary, in power alone, and its efficiency in output. Especially does this become more apparent when every rotation of the printing cylinder is utilized to take an impression, as in the Harris Offset Rotary, fed automatically. Such machines are capable of producing 4,000 to 5,000 impressions per hour, and the actual speed of travelling of the impression cylinder remains at 11,000 ft. per hour for the 4,000 impressions.

GENERAL CONSIDERATIONS.

A very strong point in favour of the offset method is that any class of paper may be printed dry. From the coarsest wrapper or deeply-embossed paper to the thinnest tissue, all can be printed dry. The hard bankpost, loan, bond and writing papers, celluloid, hard-surfaced paper and cards, are all capable of receiving excellent prints. The finest stipple work or half-tone work can be effectively printed on any kind of paper.

It is noticeable that fine half-tone transfers, which yield but a moderate impression in the hand press, come out in all their tones and details when printed from the rubber blanket. The finest results yet obtained from half-tone work have a soft photographic or collotype appearance.

The difficulties which are common in direct printing when using enamelled and other kinds of coated papers, arising to some extent from the paper being brought into contact with the damp stone or plate, are very largely removed by the offset method; whilst many papers hitherto only capable

of being printed upon from type or blocks can be used with success in this newer process.

It has been proved in several cases that when large quantities of one letterpress subject are required it is cheaper and quicker to have it transferred up and printed on an offset machine. The method is adaptable to any kind of original. The work may be patched up from half-tone transfers, copperplate transfers and letterpress transfers, and all are printed together with equal facility. Chromo-lithography, and the worked-up plates from colour blocks can be done perfectly. Masses of solid colour are equally of no more trouble to produce.

In the main the working of the offset rotary presents no difficulties to the intelligent printer. Scrupulous cleanliness in the machine, sufficient oiling, due care of the blanket, correct pressure, well-adjusted inking and damping, constitute the basis of good printing in offset rotaries as much as in flat-bed machines. Given good originals and well-ground ink, the machine minder can produce from the offset rotary at least double the quantity produced by the flat-bed machine, and of a quality which the most critical would characterize as excellent.

The demands of the offset rotary have led to the making of zinc plates as thin as 32 and 34 gauge, and at the same time the price has been reduced.

LIGHTING.

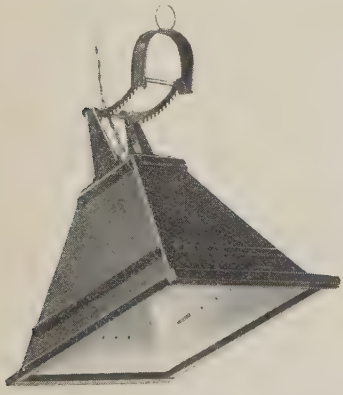
A very important consideration in printing, especially in colour work, is the artificial lighting used so largely in the printing trade. The evolution of lighting, from gas to electricity over the past forty years, has seen the gradual development of lamps which to some extent emit a light very similar in appearance to daylight, but not necessarily of the same composition as sunlight.

As the result of investigations made under carefully controlled conditions, the Industrial Fatigue Research Board in the conclusion to their report state:—

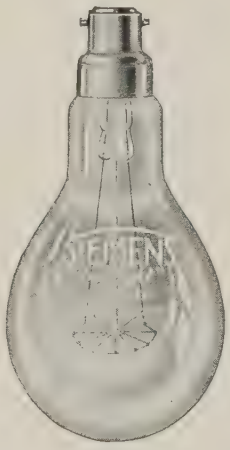
"The interests of employer and worker alike are seriously affected by inadequate lighting of composing rooms. If the illumination is less than two-foot candles, nearly one quarter of the possible output is lost, while the number of mistakes

is more than doubled and the fatigue experienced by the compositors is materially increased."

On the market there are two distinct classes of daylight lamps; one class in which the bulb or screen is stained with a suitable shade of blue, and represented by the Lamplough Restlight, Siemens Daylight lamp, Mazda Daylight lamp, Osram Daylight lamp, and the Kodak lamp, and the other class in which the source of light is an arc or gas-filled incandescent bulb, but the screen is scientifically constructed to allow the transmission of an optically and chemically pure reproduction of sunlight. This class of lamp is represented by the Lamplough Daylight lamp, Professor Gardner's "Dalite" lamp, and the Fade-Ometer.



Daylight Lamp.
Kodak, Ltd.



Siemens Daylight Lamp.
Gas Filled.

The first type of lamp with the blue stained globe will no doubt cut out some of the orange and red of the incandescent filament, and the blue of the globe will add an amount of blue to make up for the small amount emitted from the source of light. Such lamps as the Lamplough Restlight,

Siemens and Kodak, do give a good imitation of daylight, which is distinctly useful throughout a printing works. On the other hand, when colour matching is of first importance the delicate adjustments of the lamps by Lamplough and Professor Gardner stand out conspicuously as daylight, white light or sunlight producers. These two lamps have been well tried by many firms where the main point is colour matching ; possibly the Lamplough lamp has a greater intensity and consequently gives a higher proportion of sunlight. It certainly gives an average light of equal intensity throughout the year, which cannot be credited to the sun as it appears in most printing works or ink makers' factories.

NOTES BY PROFESSOR W. M. GARDNER ON COLOUR MATCHING LAMPS.

The problem of devising an artificial light by the aid of which dyers, printers and others working in colours could carry on their processes when daylight failed, was first successfully solved by the Dufton-Gardner "Dalite" lamp, which was patented in 1899. This consists of an electric arc of 500 c.p. of the enclosed type (i.e., burning in an atmosphere of nitrogen), surrounded by a lantern of glass adapted to diffuse the light and absorb those rays which were in excess as compared with the spectrum of daylight, viz., the two ends of the spectrum, red and violet. The specially made blue glass used contained copper and a trace of uranium.

The light from an arc lamp consists of two portions, that from the glowing carbon and that from the arc itself, and in the enclosed arc, the proportion which comes from the arc is much larger, and the light approximates more nearly to daylight, and, therefore, needs less correction. At the same time other radiants were found deficient in some daylight rays and hence could not be corrected.

Since the expiry of Dufton and Gardner's master patent many other forms of colour matching lamps have been introduced; the problem being simplified, and the lamps rendered more convenient by the use of gas-filled tungsten filament lamps which are not so deficient in violet rays as the older incandescent lamps.

SERVICE LIGHT LAMPS.

The Service Light Lamp as made by the Hewittic Electric Co., Ltd., Walton-on-Thames, is the much improved mercury vapour lamp as originally manufactured by the Westinghouse Cooper-Hewitt Co. Certain small disadvantages of the original lamp have now been entirely removed, and the power of the lamp, as well as its adaptability, have been much improved.

The lamp consists essentially of a glass tube exhausted of air, the ends of which are sealed. One of these seals contains a small quantity of mercury, and forms the cathode electrode. The other end has one or two small electrodes according to whether the current is direct or alternating, and constitutes the anode electrode. The current, in passing from the anode to the cathode electrode, vaporizes part of the mercury, and it is this incandescent vapour which emits the light.

The tube is 50 inches long, and one inch in diameter. Having this large surface, the light emitted is free from glare, casting no heavy shadows and having a thoroughly diffused character, giving one the impression of travelling round corners.

If one examines the spectrum of Service light, one sees that, with the exception of the red and orange radiations, which are poor from the visual point of view, one has the whole gamut of rays from yellow to violet. This means that most of the energy consumed by a Service

The Service Light—Mercury Vapour.
Hewittic Electric Co.

lamp is spent in producing rays which are of use from the visual point of view.

This, of course, leads to great economies. One Service lamp, for instance, producing 1,200 c.p., only consumes 3.5 amperes at a pressure of 110 volts, that is to say 1/3 watt per c.p. This low consumption compares very favourably with other lamps, being little more than half the consumption per watt of the metal filament lamp. By emitting the mercury vapour light from a quartz burner instead of a long glass tube, you are able to run the arc at considerably higher pressure and temperature, and you can then obtain from a Silica lamp on operation, say, on a 220 volt. D.C. supply, as much as 3,000 c.p. at a current consumption of 3.5 amperes, which works out at 1/4 watt per c.p.

These two types of Service light lamps afford indeed the two most economical types of lamps in industrial use.

Owing to the fact that the light is very actinic in character, it is of particular use for photographic purposes, a c.p. of Service light being very much more actinic than a c.p. of white light, and, therefore, it is universally used by photographers for lighting up cinema studios, for ordinary photographic studios, for photo-printing, enlarging, etc. Also, owing to the diffused and soft character of the light, it is of great use for industrial lighting, with which indeed it is claimed that the output of the worker does not fall, but in many cases increases, as compared with his output when working under daylight conditions. It is used very extensively for such things as drawing offices, machine-shop lighting, etc. In the latter connection, it is of interest to note that owing to the good diffusion of the light, it does away, in most cases, with the necessity of using pilot lamps. Service light is, of course, of particular use in cases of precision work such as printing works, colour matching, etc., and it may be mentioned that although mercury vapour is used, yet the light rays have no detrimental effect on pigments.

THE FADE-OMETER.

The Fade-Ometer is a lamp of another character and purpose which can be used to test the permanence of colour of printing inks and dyes. The source of light is an enclosed violet carbon arc and if the spectrum given by the arc be

examined, it will be seen that at the violet end of the spectrum there is a very close reproduction of the violet end of the solar spectrum. This is the secret of the Fade-Ometer's value; its rays contain the same elements as the fading rays of sunlight with the added advantage that tests equivalent to many days' exposure to sunlight may be made in a very short space of time. In addition the light is of constant value at all times during the life of the apparatus. This means that a test can be reproduced at any time so that two or more Fade-Ometer users in different places can make comparative tests with the knowledge that all are working on the same definite basis.

The carbon arc is arranged in the centre of a metal cylinder known as the cabinet. This is constructed to carry twenty or forty samples at one time, all equally exposed to the Fade-Ometer's rays. The intensity of the arc represents the sun's light in June and July, and the distance of the samples from the light modifies the heat to an average of the hot days of the year. The addition of an open dish of water at the bottom of the cabinet supplies the humidity usually registered on such hot days.

Under these conditions it is possible at any time of the year to test the permanence of printing inks which will in due course have to be exposed to daylight. Tests can easily and quickly be made showing how printed matter will appear after, say, six months' or a year's exposure to daylight. If all printing ink makers would use this apparatus they could classify their inks on a definite permanency basis, so that a print or poster would fade equally all over. In cases where fading of any sort is not desirable, certain inks could be used with the definite assurance that no fading would result even after many months' exposure to bright sunlight.

This apparatus is in use in many parts of the world, including Great Britain. In this country the number of users is at least seven by dye-stuff makers, six dyeing plants, four ink manufacturers, three lithographic printers, one paper mill, three paint and varnish makers. In America there are at least 108 instruments in the same industries.

It is manufactured by the Atlas Electric Devices Co., Chicago, the British agents being Messrs. Kelvin, Bottomley and Baird, Hither Green Lane, London, S.E.

MISCELLANEOUS.

Although most printers have means of their own for carrying out the routine of printing, yet it may safely be stated that there are several articles on the market which tend to make work easier. It should not be thought that most of these articles are simply made to sell; they are not. Most of them are the result of the long experience of actual craftsmen who have ultimately been prevailed upon to place the recipes in the hands of the manufacturers who are able to produce in bulk and introduce these specialities to the whole trade. Further, it should not be overlooked that in most printing ink firms there are some of the best letterpress and lithographic printers who are to a large extent responsible for most of the specialities offered.

The number of these aids to printing is not quite so large as it was some ten to fifteen years ago, but still too numerous to emunerate.

These articles are made by such firms as Mander Bros., Ltd., F. Horsell & Co., Ltd., B. Winstone & Sons, Ltd., John Kidd & Co., Ltd., Lorilleux & Bolton, Ltd., Gilby and Herrmann, Ltd., Algraphy Ltd., Hunters Ltd., Penrose & Co., Ltd., W. R. Nicholson, Ltd., Pictorial Machinery, Ltd.

The specialities include ink reducers or softeners, scum preventives, stone and plate cleaners, etching solutions (such as Zetch), Inkeaser, Tint Preventer, Litho. Tonic, Rotarine, Wax Varnish, Plateen, Tinteen, Print-aid, Offset Reducer, Lakoset, Anti Set-off Solution, Elbagreen, transfer papers of the "Ever-damp" variety, transfer inks or crayons for all purposes. Most of the above firms have also small appliances to assist in handling and preparing stones and plates and rollers.

In fact, at present there is little or no need to make up solutions, pomades, etches, etc., for all of them are obtainable from the firms already mentioned. It may be added that most of the specialities have been thoroughly tested in the business and in most cases have been found to do what the makers claim for them.

INDEX.

PAGE

Acetic Acid 89
Acids 89–95
,, and their Actions 2, 3, 8, 11, 12, 13
Acid Tests for 95–96
Acmetint 160
Actinometer 139
Albert & Cie—
Rotary Offset, one-colour "Frankenthal" ... 253
Rotary Offset, two-colour ... 255
,, Reel-fed ... 255
"Alco" Zinc Plates 76
Alcohol 96
Algraphy Plates, Treatment of ... 73
,, Ltd. 73, 314
,, Syndicate 75
Alkalis and their Action on Stone, Zinc & Aluminium 4, 10, 13, 14, 47
Alkalis, Tests for 95–96
Allen, C. J. E., Bedplate ... 77
Alterations and Additions—
Aluminium 53, 74
Zinc ... 37, 65, 66, 68, 69, 71
Aluminium—
Acids, Action on : ... 8, 9
Acetic Acid 8
Citric ,, ... 8
Hydrochloric Acid ... 8
Nitric Acid 8
Oxalic ,, ... 8
Phosphoric Acid ... 8
Sulphuric ,, ... 9
Alkalis, Action on : ... 47
Potash, Caustic ... 9
Soda 9, 47
Alterations and Additions ... 53
Beds for ... 40, 64, 67, 76, 78
Chemical Properties ... 6–11
Chemically compared with Zinc 10
Cleaning Grained Plates ... 108
,, for Printing ...60, 114
,, for Proving ... 45, 49
,, New Plates ...24, 107
,, Old ,, ...24, 107
Compared with Zinc ... 88
Compared with Stone ... xiii
Discovery and Extraction ... 6
Doctors 32, 67, 112
Etches 44. 110
Etch for Relief 57
Graining 19–27, 86

PAGE

Aluminium—
Introduction ... xiii, xv
Originals, Treatment of ... 44
Photography on 118
Photographic Transfers on 51
Preparing Plate for Transfer 47, 109
Preservation and Storage ... 55
Printing from 46, 57
Re-preparing ... 24, 53, 107
Re-sensitizing ... 53–55, 113
Resists 110
Rolling-up 46, 48
,, after Storage ... 56
Set-offs 55, 114
Transfers to 47–51
Transfer Ink 51
Transposing 56
Treatment tabulated ... 116
,, Notes on ... 50, 51
Aluminium and Zinc Alloy—
Experiments with 16
"Alzene" 16
Aluminium Litho-plate Co., Introduction xiii
Alums 10, 14, 100
Alum-acid Bath 24
Alum-acid Preparation 27
Alzene Alloy 16
Ammonia 100
,, Bichromate 101
Ammonium Silico Fluoride ... 82
,, Acid Fluoride ... 81
,, ,, Phosphate ... 81
,, Bi-phosphate ... 82
Aniline Set-offs ... 39, 55, 68, 114
Atzol 67
August-Hunter Development Syndicate, Photographic Composing Machine ... 173
Ault & Wiborg 286
Autograph Transfers, Treatment of 49
Automatic Feeders (see Feeders) 188, 189, 266–280

Balsam of Tolu 59, 99
Balsams, Tolu, Peru, Storax, Canada 59, 61, 99
"Bautzen" Two-colour Offset Rotary 246–247
Bed-plates ... 40, 64, 67, 76–78
,, How to use and Illustrations of ... 76–78

PAGE
Berlin Transfer Paper 51, 74
Bichromates, Potassium, Sodium, Ammonia 101
Bittner, H.—Patent Method ... 83
Blanket for Offset Work 281–284
,, ,, by W. R. Nicholson 283
Blanket on Cylinder 63
,, Rubber, for Offset Work 281–284
Blecher, Treatise by 81–82
Block, G. H. ... xv, 16, 17, 66
Boiled Oil 98
Box for Printing Down ... 129, 163
Breugnot, Early use of Zinc ... xii
Bringupine 113
British Printer, The 160
British Thomson-Houston Co. Motors 260
Broad, Tom 51
Bronzing : Effect on Plates ... 59
,, on Offset Rotaries 282
Bullock & Mullaly ... ... xiii, 6

Calcium, and the Group of Alkaline Earth Metals ... 2
Calcium as a Metal, and its Actions 2
Calvert's No. 5 or No. 2, see Carbolic Acid
Canadian-American Machinery Co., Ltd., Camco or Rotary Feeder 271
Canada Balsam, in Printing Ink... 61
Carbolic Acid, Calvert's No. 2 and No. 5 ... 34, 41, 42, 43, 48 56, 90
Chapman & Co. xii
Chromic Acid 31, 32, 87, 90
Chromium 102
Chromo Papers : Effect on Plates 63
Chromosol 67
Citric Acid 90
Cleaning New Plates 107
,, Old Work off 107
,, (or Sensitizing) Grained Plates 108
Cleaning for Proving—
Aluminium 45, 49
Zinc 33
Cobalt linolate, oleate, acetate, borate, resinate, benzoate ... 99
Connolly, Francis J., Ltd., Marinoni-Voirin Machines 218–228
Copal Varnish 98
Crabtree, R. W. & Sons, Machines—
Offset Proving and Reversing Press 294–297
Rotary Offset Two-colour 189, 191
,, ,, One ,, 188–190
,, ,, "Little Ensign" 189, 192, 193
,, ,, Tinplate ... 193
Self-adjusting Spring Gripper 195
Crawford, J. ... ... viii, 39

PAGE
Creosote 90
Cresylic Acid ... 42, 43, 48, 90
Cross Paper Feeder Co., Ltd., Cross Feeder 273
Cylinder Blanket (see Blanket)

Damperless Printing 62
Damping and Dampers, for Printing ... 58, 60, 61, 62, 290
Damping Water and Scum ... 60
Day & Son xii
Decco Turps Substitute ... 63
Diachylum 59, 99
Dickes, W. xii
Dickes, W.—Patent Method ... 83
Direct Photography on Metals 118, 132
Doctors 37, 67, 112
Driers 97
Dronsfield, A. J., A.M.I.MECH.E. Universal Feeder ... 266–269
Dry Lithography 61
Drying Sensitized Plates 134–137

Eberhard, H. W. 17
Eberle, E.... 82
Electromotors—see Motors 257–265
Electromotors, Ltd., Motors ... 257
Enders, B. 51
Erasol 67
Etches for Aluminium Plate Work 44, 110
Etches for Zinc Plates 31, 33, 110, 131
Etch of Hemi-chloride of Copper 57
,, for Möller's Patent Plate ... 64
Etches with Gum 111
Etching Zinc and Aluminium into Relief 57, 111
Ether 100
Eyres, J. & S., Ltd., Attachment to Flat-bed Machines for Offset Printing 217

Faber & Schleicher, Offset Proving and Reversing Press ... 306
Fado-Meter 312
Feeders—Automatic and Semi-Automatic :
"Camco" 271
"Cross Continuous" ... 273
"Dexter" 269
Harris 230
H.T.B., "Slogger" ... 275
H.T.B., Semi-Automatic ... 278
Rotary 271
"Universal"... 266
Waite & Saville's Semi-Automatic 216
Firmasol 67
Fischer, Paul 51
Flat-bed Offset Attachment ... 217
Fuchs & Langs' Graining Machine 21
Offset Proving and Reversing Press ... 304
Tinplate Rotary—
"Rutherford" 238

PAGE
Formaldehyde 103
French Transfer Paper 74
Furnival & Co.'s Machines—
Direct Rotary 199
Rotary Offset, One-colour... 197
,, ,, "B" model ... 198
,, ,, Two-colour... 200

Gallic Acid 31, 33, 91
Gall Nut Solution and Etch ... 31
Gardner W. M. (Professor)
Dalite Lamps ... 309–310
Gelatine 103
General Considerations ... 307–310
German Lithographers' Year
Book 60
Gilby & Herrmann 51
Gold Size 98
Goodman, J. 82
Graining Machines 16
,, Metal Plates 19, 75
,, Machine, Illustrations
20, 22–25
Grains on Plates, Microscope
Enlargements of 28–30
Grainless Negatives by
Metzograph Screen ... 160
Grinding and Graining Metals ... 19
Grubb, Mr. xi
Gum in Etches 111
Gum, its Action 4

Half-tone Transfers on Metals ... 51
Harris Offset Rotary Machines—
One colour 228
Two colours 230
Feeder 230
Trade Amalgamation ... 228
Hemi-Chloride of Copper Etch... 57
Hewittic Electric Co., Ltd.,
Service Light — Mercury
Vapour Lamp 311
Heyl, G. E. 17
Hoe, R. & Co.'s Machines—
Rotary Offset one colour ... 234
,, ,, two ,, ... 235
Direct Rotary one ,, ... 236
,, ,, two ,, ... 237
,, ,, multi ,, ... 237
Holmes, J. H. & Co., Motors ... 262
Horsell, Frank & Co., Ltd.—
Graining Machine 20
Inks, etc. 314
Lithographic Machine Rollers 286
Parker Plates 70–73
Seamless Packing 75
Silicatine Graining Grit ... 71
Transfer Paper 51
H.T.B., Ltd., Feeders 275
Huebner-Bleistein Machines,
Photo-composing ... 152–155
Hughes, Treleaven & Co. ...63, 113
Hull Zinc Plate 16

PAGE
Hunters, Ltd. 176
Heating Unit and Stand ... 136
Lights 124
Printing-down Frame 123, 127, 159
Register Printing-down
Frame 159
Repetex 156
Sensitizing Film 137
Specialties 314
Step-and-Repeat Projector 155
Transfer Paper 51
Whirlers 120, 134
Husnik, Julius 62
Hydrochloric Acid 92
Hydrofluosilicic Acid 25, 92

Ideal Rollers 74, 285–286
Imperial Dry Plate Co., Negative
Paper 172
Industrial Fatigue Research
Board 308
Inking and Rollers for Printing ... 58
Inks, Printing 59–60, 69
,, Drawing 70
,, and Specialities 314
Izal Oil 91

Jenkins, F. 51
Johnston, T. R. xvi
Johne-Werk Co., Bautzen Two-
colour Offset Rotary 246–247

Kelvin, Bottomley & Baird,
Fade-ometer 312
Kidd, John & Co. 314
Kleim & Ungerer, Universal
Feeder 266
Knapp, W. 82
Kodak Negative Paper 171
,, Light 309

Lakeman, A. H., Ltd.—
"Bautzen" Two-colour
Offset Rotary ... 246–247
M.A.N. Reel-fed Offset
Rotaries ... 240–246
L-AN-B ... 38, 52, 55–57, 58–61, 82–87
Lanston Monotype Corporation, Ltd.—
Harris Rotary Offset
Machines ... 228–232
Lay Marks : Zinc 35
Layton, C. & E. xii
Layton, C. & E., Zinc Plate Bed 64
Lead Acetate, Hydrated-
carbonate, Chromate ... 99
Lemercier, Ink 70
Letterpress and Lithographic
Printing Combined ... xvi
Lights, Photographic ... 124–125
,, Colour Tests ... 312–313
,, Workrooms ... 308–312
Linotype & Machinery, Ltd.—
Direct Rotary Machine ... 204
Graining Machine 24
Press... 37
Rotary Offset Machine ... 203

PAGE
Litharge 98
Lithography, Chemical Basis of 4, 5
Lithographers' Year Book, German 60
Litho Plate Co ... ... xiii, 64
Lithographic Stone—
Constitution of 1
Re-actions of 1
Treated with Acetic Acid ... 3
,, ,, Alkalis ... 4
,, ,, Alum ... 4
,, ,, Bicarb. of Soda 4
,, ,, Citric Acid ... 3
,, ,, Gum Arabic 4
,, ,, Hydrochloric Acid 3
,, ,, Nitric Acid... 3
,, ,, Oxalic Acid 2
,, ,, Phosphoric Acid 3
,, ,, Sulphuric Acid 3
,, ,, Tartaric Acid 3
,, ,, Whiting ... 4
Lithotex 126, 132, 133, 143
Litho Zinc Plates, Treatment of 66
Litmus 96
Lorilleux & Bolton 314
Lowe & Brydone, Ltd. 83
Lye 102

M.A.N. Offset Rotary Machines—
Maschinenfabrik Augsburg-Nurnberg, A. G., Rotary Offset Reel-fed, for several colours... 240–246
Mailander, J. G.—
Offset Proving and Reversing Press 303
Rotary Offset Machine ... 251
Mander Bros. 314
Manganese, Linolate, Oleate, Sulphate, Dioxide, Borate, Resinate, Benzoate 99
Mann, George & Co.—
Rotary Offset and Perfecting 178
,, ,, Two colour... 178
,, ,, One ,, 181–184
,, ,, ,, ,, "Baby" 184
,, ,, Tinplate ... 186
Bedplate (C. J. E. Allen's) ... 77
Offset Proving and Reversing Press 297
Graining Machine ... 23
Marbles for Graining ... 20, 75, 82
Glass, Wood, Porcelain ... 20
Marinoni-Voirin—
First Offset Machine (1884) 219
Graining Machine 25
Offset Reversing and Proving Presses 299–301
Rotary Offset, Two colours 219
,, ,, Perfecting ... 222
,, ,, One colour ... 224
,, ,, "Monobloc" 226
,, ,, "Bijou" ... 227
,, ,, Three colours 227

PAGE
McIntosh, G. 51
McKinley & Co.—
Distributing Roller... ... 289
Graining Machine 21
Mercury 103
Mercury Vapour Lamp... ... 311
Metalithography 82
Metallic Soap 33, 47
Metals, Advantages of xii
Metal Plate Printing, as an Aid to Typography xiii
Metals for Direct Transfers ... 51
Methylated Spirit 97
Metzograph Screen 160
Mogul 113, 141
Möller's Patent Zinc Plates xii, 64
Molybdate of Soda 35
Motors—
British Thomson-Houston 260
Electromotors, Ltd. ... 257
Holmes, J. H. & Co. ... 262
Mullaly & Bullock ... ... xiii, 6
Mushroom Top Grain 26

Negatives—
Celluloid 163–170
Paper 171, 172
Typon 163–170
Nicholson, W. R. ... 283, 314
Nitric Acid 93
Nitric Acid-Alum-Water ... 36
Nottingham, Zinc Plate Printing xi

Offset Proving Presses, see Presses 294–306
Offset Rotaries ... ... Chap. xviii
Ogden Multiple Duplicating Machine 148–152
Ordnance Survey xii
Oxalic Acid 94
,, ,, on Aluminium ... 56
Oxidation on Zinc (basic carbonate) 14
Oxidation on Aluminium ... 8, 44

Pantone 61
Paper Negatives 163–172
Paraffin 104
Paramount Offset Powder ... 114
Parker Printing Plates, Treatment of 70
Parker Printing Plates, Etch ... 32, 71
Penrose's Litho-Zinc Plates, Treatment of 66-70
Penrose & Co. 176
Lights 125, 140
Printing-down Frames ... 121
,, Box ... 129
Reversing and Proving Press 301
Specialities 314
Whirlers 120, 135
Permanent Set-offs 39, 55
,, Set-off Powders ... 39

PAGE
Permaneo... 87
Petroleum 104
Phenol 91
Phenolphthalein 96
Phirmold 113
Phosphoric Acid 94
Photographic Composing Machine 173–176
Photographic Processes on Metals 118–176
Photographic Processes from Grainless Negative 160
Pictorial Machinery Co.—
Lithotex ... 126, 132, 133, 143
Printex Negative Printer 146–148
Printing-down Frame ... 126
Specialities 314
Step-and-Repeat Machine 143–146
Whirler 138
Planographic Printing ... ... xiv, 1
Pneumatic Printing Frame, Illustration ... 121, 123, 126, 127
Potassium Bichromate Etch 32, 33, 40, 42, 65, 68
Potassium Bichromate, Hydrate (Caustic Potash) 101
Potter Co.—
Premier-Potter Offset Rotary 238
Trade Amalgamation ... 228
Preparing Plates for Transfers ... 109
Prepasol 67
Preservation and Storage—
Aluminium 55
Zinc 41
Preserving Ink 55
Presses, Offset, Proving and Reversing 294–306
"Concordia," Faber and Schleicher 306
Crabtree, R. W. & Sons 294–297
Fuchs & Lang's 304
Mailander, J. G. 303
Mann, George & Co. ... 297
Marinoni-Voirin ... 299–301
Penrose & Co., "Imperial" 301
"Reverso," Waite & Saville 294
Wagner, Charles 304
Pressure for Printing 59
Price, W.P. 63
Price, Service & Co.—
Albert & Cie, Offset Machines 253–256
Printex Negative Printer 146–148
Printing-down 132
Printing-down Frames 121, 123, 126, 127, 159
Printing-down Box ... 129, 163
Printing from Metals 18, 57
,, ,, Aluminium Plates 46, 57
,, ,, Zinc Plates ... 40, 57
Process Engravers' Monthly ... 82
Proving Presses for Offset, see Presses.

Railway Magazine, 1835... ... xii

PAGE
Ratcliff, J. & Sons—
Flat-bed Offset 207
Rotary Offset, one colour ... 207
Tinplate, Rotary 211
,, Flat-bed, "Reliable" 213
Recipes for Metalography 107–114
Renova Offset Powder 114
Repetex 156
Resists 110
Re-sensitizing 113
Reversing for Offset Rotary work 290–294
Reversing Presses, see Presses 294–306
Richter, Paul xiii
Roderzone ... ... see L-AN-B
Rollers for Printing ... 59, 285–289
Rolling-up, after Storage, Zinc Plates 43
Rolling-up Aluminium Plates ... 55
Rosin Etch 41, 57
Rotary Machines... ... Chap. xviii
Rowan, H. xi
Rubber Rollers 58, 75

Sand, for Graining ... 71, 75, 82
Sandblast for Graining—
Tilghman's Machine ... 16
Scholefield, Joseph 62
Scholtz, Christian: Graining Plates 26
Schmautz, Rollers 289
Scum, Its Prevention and Treatment—
Aluminium 46, 60, 114
Zinc 33, 35, 36, 60, 68, 69, 71, 114
Seamless Packing 75
Senefelder, A. J. xi
Sensitizing Metal Plates for Photography ... 118, 133
Service Light Lamp 311
Set-offs—
On Zinc 39
,, Aluminium 55
,, Prepared Plates ... 39, 68
,, Algraphy Plates ... 74
Set-off Powders ... 34, 39, 74, 114
Sheridan Machinery Co., Ltd.—
Dexter Feeder 269
Siemen's Daylight Lamp ... 309
Sieves for Sand 75, 82
Silicacine Graining Grit ... 71
Silicate ... ... xii, 83
Six-inch Ordnance Survey ... xii
Sodium, Bichromate, Hydrate (Caustic Soda) 101
Sodium, Silicate 104
Soldans, Ltd.—
"Vomag" Reel-fed Offset Rotary Machines 247–251
Southampton xii
Specialities and Inks 314
Speed of Printing on Offset Rotaries 306
Standphast Offset Powder ... 114
Step-and-Repeat Machines 143, 145, 146, 155

PAGE

Stisted, Mrs. xi
Storage—
Aluminium Plates 55
Zinc Plates 41, 65
Strecker, Dr. Otto C. ... ... xv, 6
Strecker Process 80–87
Sulphuric Acid 95
Surface Printing 1
Symmons, Guy 61

Talc ... 44, 45, 48, 55, 57, 68–72, 74, 81, 110, 111, 113
Tannic Acid 91
Terebene 98
Tinplate Printing Machines 186, 193, 211, 213, 238
To keep Plates clean in Printing 114
Transfer Ink 70, 109
Transfer Paper—Berlin, French 51, 74
Transfers, Treatment of—
Aluminium 47–51
Zinc 36
Transfers Direct on Metals ... 51
Transposition on Zinc 38
,, ,, Aluminium ... 56
Treatment of Zinc for Lithographic Printing by the Special Process of Dr. Strecker... ... 80
Treatment of Zinc, tabulated ... 115
,, Aluminium ,, ... 116
Trist, Ronald 61
True to Scale 118
Turmeric 96
Turpentine and Substitutes ...63, 105
Typary & Typon Processes ... 161
Typon Process ... 129, 161, 163–170

Vandyke Process... ... 118-132, 141
Vanhymbeeck, Ink 70
Venice Turpentine 59
Victory Etch 87
Vomag Offset Rotary Machines—
Vogtländische Maschinenfabrik A. G. Offset, Four colour, Sheet-fed, "Sandbas," and "Messamt" ... 247–251

Waite & Saville's Machines—
Rotary Offset, one colour ... 213
,, ,, two ,, ... 215
Semi-Automatic Feeder ... 216
Reversing and Proving Press, "Reverso" 294
Walker Bros.—
Potter Offset Rotary Machine ... 238–240
Wheeler's Metzograph Screen ... 160
Whirlers 120, 134, 135, 138
Whirling 137
Whiting Treatment ... 36, 38, 54
Winstone's—
Reversing Method 292
Transfer Paper 51, 292
Victory Etch 87

PAGE

Wogdon Press—
Offset, Proving and Reversing 303

Xylol 106

Zetch 36, 38, 45, 52, 55, 57, 58–61, 74, 79, 80, 111, 131, 141
Zinc—
Action of Acids on :
Acetic Acid 14
Citric 14
Hydrochloric Acid ... 13
Nitric Acid 13
Oxalic 14
Phosphoric Acid ... 14
Salt 14
Sulphuric Acid ... 14
"Alco" 76
Alkalis, Action on 13, 14
Alum 14
Beds for ,, ... 40, 64, 67, 76–78
Chemically Compared with :
Aluminium 14
Stone ... ... xiii, 12–14
Chemical Properties of ... 12–15
Coloured Pigments, Effect of 35
Compounds of 14–15
Oxydation of 41
Physical Properties of ... 12
Zinc Oxide, Sulphate, Chromate 99
Zinc Plates—
Alterations and Additions 37
Cleaning Grained Plates ... 108
,, for Proving ... 34
,, in Printing ... 114
,, New Plates ... 107
,, Old Plates ... 107
Doctors 32
Etches 33, 34, 35, 64, 110, 111
Etch for Relief 57, 111
Graining and Grinding 19–28, 75, 108
Gauges of 15
Hull 16
Lay Marks 35
Litho Zinc 66–70
Originals, Treatment of ... 31–35
Parker 70–73
Photography on ... 118–176
Preparing Plate for Transfer 109
Preservation and Storage ... 41
Printing from 40, 57
Re-preparing 27
Re-sensitizing 113
Resists 110
Rolling-up 33
,, after Storage ... 41
Set-offs 39, 55, 114
Thin Plates 15
Transfers to 36
Transfer Ink 109
Transposing 38
Treatment Tabulated ... 115

ADVERTISEMENTS.

Where L&M Lithographic Presses are manufactured

THE WORKS OF LINOTYPE AND MACHINERY LIMITED, ALTRINCHAM, CHESHIRE.

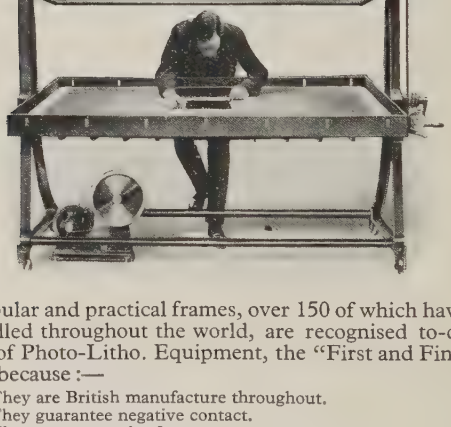
Write for full particulars of

L&M Direct Litho Rotary
L&M Sheet-Fed Offset Perfector
L&M Offset Rotary L&M Transfer Press
L&M Graining Machine

LINOTYPE & MACHINERY LTD.
9 KINGSWAY, LONDON.

"LITHOTEX"

Exhibition Model Printing-Down Frame



These popular and practical frames, over 150 of which have already been installed throughout the world, are recognised to-day as the Standard of Photo-Litho. Equipment, the "First and Finest on the Market," because :—

1. They are British manufacture throughout.
2. They guarantee negative contact.
3. They are easy and safe to operate.
4. They have safety raising gear.
5. Electric motor (D.C. or A.C.) with control unit, and all-enclosed vacuum pump, with visible oil level, are included.
6. They are of rigid, but light, all-metal construction.
7. They have quick acting shut-out blinds, masking any desired area of metal plate.

Made as standard in two sizes: For plates $65 \times 48\frac{1}{2}$ *in. and* $45 \times 38\frac{1}{2}$ *in. Prices on application.*

PICTORIAL MACHINERY LIMITED

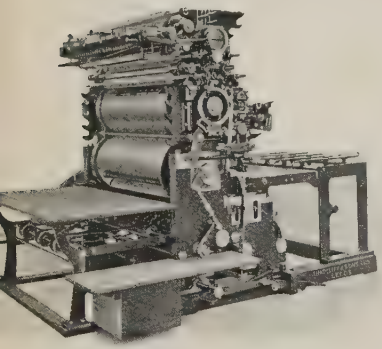
7 FARRINGDON ROAD LONDON, E.C. 1

JOHN RATCLIFF & SONS LTD.

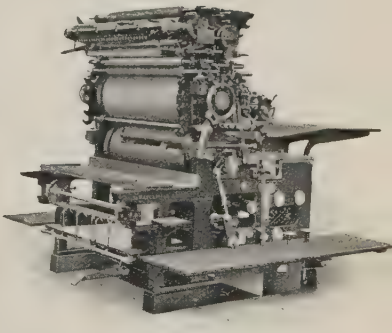
Telephone 27150.
Telegrams: Ratcliff, Wortley, Leeds

Junction Foundry, LEEDS

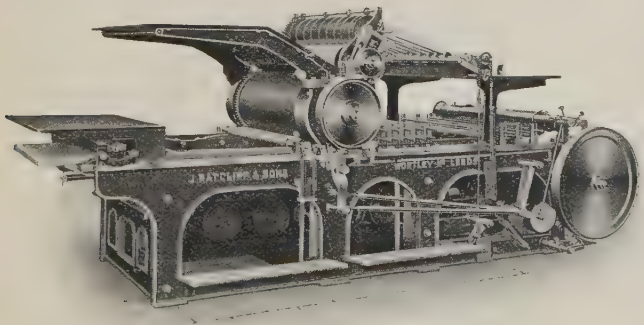
Makers of Lithographic Printing Machines for both
Tin and Paper, Offset and Direct, Rotary and Flatbed



Rotary Tinplate Printing Machine, already installed in the principal houses in England and Australia.



Rotary Offset Machine. Simplest and most accessible on the market, and giving every satisfaction.



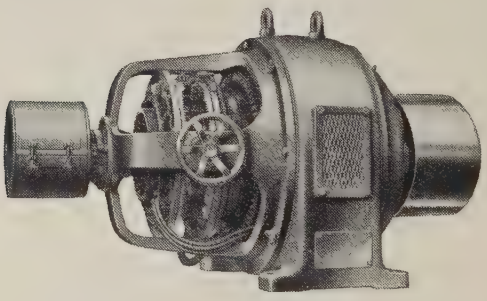
Flatbed Offset Machine, suitable for either plate or stone, Offset or Direct. Nearly 200 of these machines sold and doing highest-class work.

Makers of the celebrated Reliable Litho. Machine; also makers of Card Mounting Machines, Plate Graining Machines, Ink Grinding Mills, Litho. Transfer Presses, Iron Bedplates, also Roller Skins, etc.

Contractors to India Office and H.M. Crown Agents.

B T-H

Motors
for
Press Drives



For many years this Company has supplied variable and constant speed motors, alternating and direct current, for every branch of the printing industry, and control gear, either hand-operated or through push buttons which can be situated in the most convenient positions, ensuring safety and economy with absolute reliability and continuous service.

The British Thomson-Houston Co., Ltd.

ELECTRICAL ENGINEERS AND MANUFACTURERS

Head Office: Rugby——————London Office: Crown House, Aldwych.

Works: Rugby, Birmingham, Willesden, Coventry and Chesterfield.

The Modern Lithographer will find his every need carefully provided for by The House of B. Winstone & Sons, Ltd

Established 1848

Finest Quality Materials
Free Technical Advice
& the most Comprehensive Service in the Trade.

B. WINSTONE & SONS, Ltd
100 & 101 SHOE LANE,
LONDON, E.C. 4.

MANN

GEORGE MA

The British Offs

We Manufacture:—

Two-Colour and Perfecting and Single-Colour Rotary Offsets, in all sizes.

Tinprinting Machinery.

Direct Rotary Lithos.

Offset Proving & Reversing Presses, Graining Machines Ink Mixers, Transfer Presses etc., etc.

HENRY STREET, GRAY'

TELEPHONE: MUSEUM 5740 (3 lines). CABLES: LITH

& CO., LTD.

MANN

inery Specialists.

Our Agents are :—

Australia & New Zealand :—

R. Collie & Co. Pty., Ltd.,

194/196 Little Lonsdale Street, Melbourne;
230 Clarence Street, Sydney; and at Adelaide,
Brisbane and Perth.

South Africa :—

W. H. Smith & Co., Ltd.,

Argus Buildings, 122 St. George's Street,
Cape Town.

China :—

Andersen, Meyer & Co., Ltd.,

Shanghai.

N ROAD, LONDON, W.C.1

NDON. TELEGRAMS: LITHOMAN, HOLB. LONDON.

MARINONI-VOIRIN

THE OLDEST FIRM OF LITHOGRAPHIC MACHINE BUILDERS IN THE WORLD

MARINONI-VOIRIN

most advanced Offsets for beautiful, accurate and perfect printing of every character; commercial, half-tone and multi-colour.

These fast—yet silent—machines are a necessity to the modern printing office.

Ask us for our books—and then let us give you a demonstration in proof.

Rotary Offsets—Single, Multi-Colour and Perfecting; Rotary Newspaper, Book and Magazine Machines; Sheet-fed Rotary Photogravure Machines; Offset Proofing Presses; Photo-Litho Equipment.

FRANCIS J. CONNOLLY, LTD.

Union Works, 60 Park Street, Southwark, London, S.E. 1

Telephone: Hop 3532, 2265. Telegrams: "Franjicon, Boroh, London." Code: Western Union (5 letter).

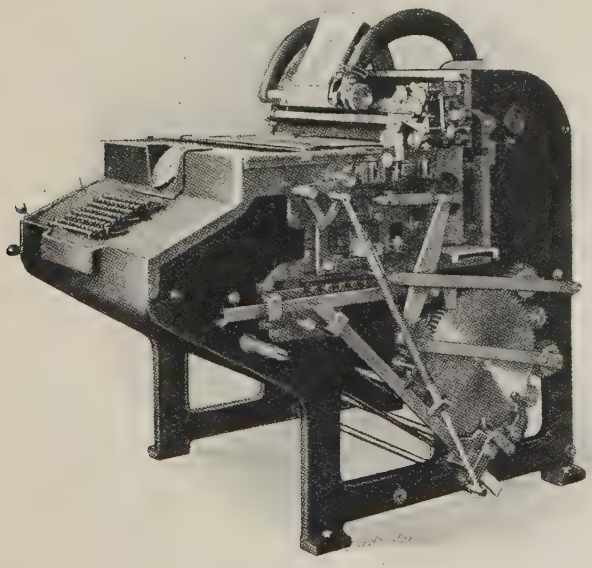
Australia - - - S. Cooke Pty., Ltd., 225-231 Queen Street, Melbourne
South Africa - Evelyn Haddon & Co., Ltd., P.O. Box 1431, Cape Town

A COMPLETE COMPOSING ROOM

for the

Offset Lithographer & Rotogravure Printer

is contained in the



TYPARY & TYPON

EQUIPMENT

COMPACT :: EFFICIENT :: ECONOMIC

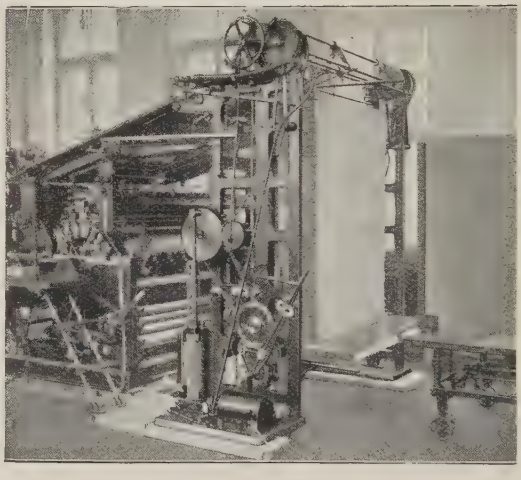
Full particulars from

TYPARY & TYPON CO. LTD.

1-4 RED LION PASSAGE,

FLEET STREET, LONDON, E.C. 4.

TYPON TYPAR TYPON



FEED MORE — PRINT MORE

There are two ways of getting increased production. One is to instal more presses and employ more machine minders. A better way is to fit "Universal" Sheet Feeders to all worthwhile presses, because each machine minder on a "Universal"-equipped press produces from 25 to 50% more work than one in charge of a hand-fed press. Better register, and earlier deliveries are also accruing advantages.

The owners of 10,000 presses have already decided in favour of "Universals." They know that no other feeder can give the same assurance of unfailing functioning, rapid change-over, and instant adaptability to all printing conditions and all weights and varieties of paper. Besides, the "Universal" costs less!

Why don't you write to-day?

A. J. Dronsfield, British Representative for—

KLEIM & UNGERER, 25 LIME ST., LONDON, E.C.3.

Telephone: Avenue 4002.

THE "UNIVERSAL" AUTOMATIC SHEET FEEDER

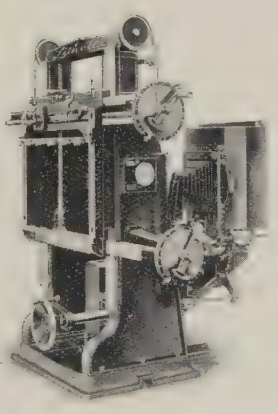
THE WORLD'S FINEST MECHANICAL FEEDER

"LITHOTEX"

Standard Step-and-Repeat Machine.

Installed in the leading printing establishments in the following countries:

Australia
Austria
China
England
Egypt
Germany
Hungary
Italy
Silesia
Russia
South America
U.S.A.
etc.



In daily use for the following purposes:

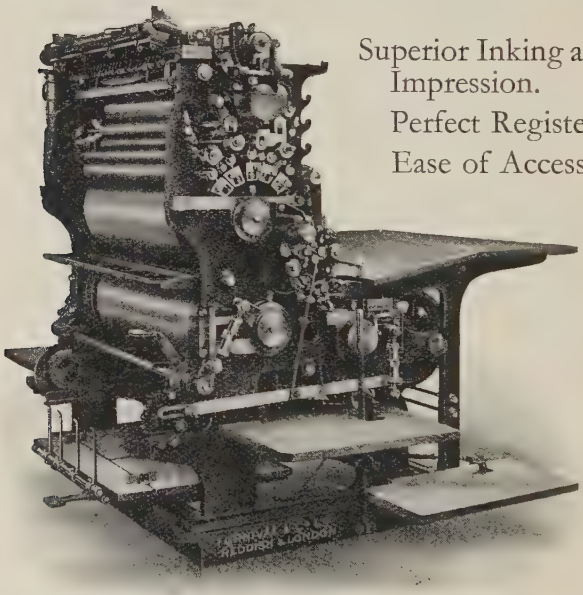
Tin Printing
Textiles
Cartons
Stamps
Paper Money
Playing Cards
Map Reproduction and All Repetition Work

The Lithotex Standard Step-and-Repeat Machine has all those refinements of detail and construction which are the result of many years' practical experience. It will be found in every way worthy of the world-wide reputation which it has earned for absolute exactitude and maintenance of this exactitude even after years of use.

PICTORIAL MACHINERY LIMITED
7 FARRINGDON ROAD LONDON, E.C. 1

THE "FURNIVAL"

Single-Colour Offset Press



Superior Inking and
Impression.
Perfect Register.
Ease of Access.

SPEED UP TO 4,000 PER HOUR!

Write for details to the Manufacturers :

FURNIVAL & CO. LTD. REDDISH, STOCKPORT

also at

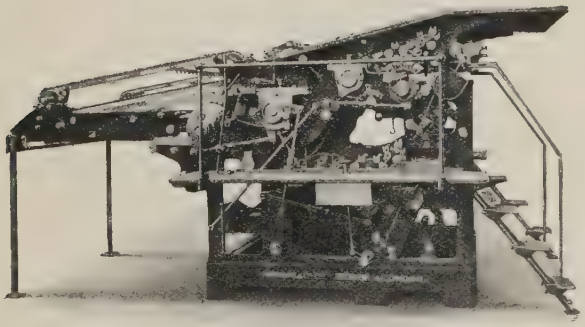
102/108 CLERKENWELL ROAD
LONDON, E.C. 1

and

215 BOTHWELL STREET
GLASGOW

THE "FURNIVAL"

Two-Colour Offset Press



UNEQUALLED FOR

Rolling Power,
Solidity of Impression,
Accurate Register.

It prints work on which others fail.

Investigate the merits of this Press.

FULL PARTICULARS FROM

FURNIVAL & CO. LTD. REDDISH, STOCKPORT

also at

102/108 CLERKENWELL ROAD LONDON, E.C.1 *and* 215 BOTHWELL STREET GLASGOW

WE HAVE MANUFACTURED

OFFSET INKS

SINCE THE BEGINNING OF THE PROCESS.

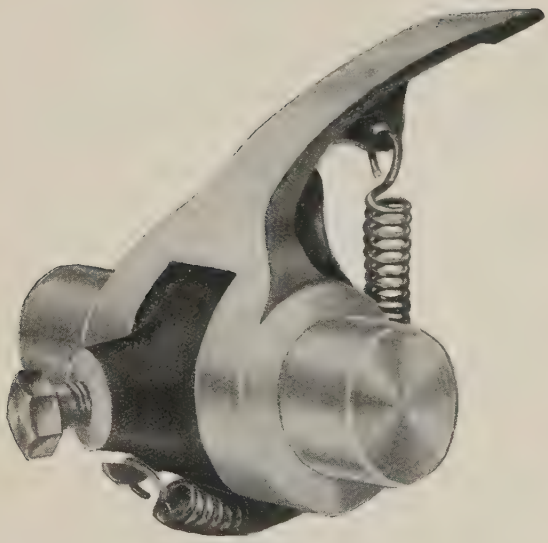
OUR RANGE OF COLOURS
IS UNSURPASSED.

TRY "RESILIO"
RUBBER BLANKETS

THE BLANKET WITH THE
PERFECT PRINTING SURFACE.

SUPPLIERS OF SUNDRIES AND SPECIALITIES
FOR THE OFFSET PRESS.

GILBY & HERRMANN LTD
PRINTING INK MANUFACTURERS
EST 1888
7&8, Plumtree Court,
Farringdon St. LONDON, E.C.4.



ONE OF THE MANY

VALUABLE PATENTED DETAILS

WHICH MAKE

SUPER- Ensign -OFFSETS

SUPER-OFFSETS

WRITE: R. W. CRABTREE & SONS, LTD.
WATER LANE, LEEDS.

INTIMATELY CONNECTED WITH THE

Photo-Lithographic Process

since its inception, the benefit of our many years of experience of its various phases are at your disposal. Small and large installations for the most varied classes of work have been carried out by us.

It will certainly pay YOU to consult us.

Our particular SPECIALITIES include :

The "H.L." STEP AND REPEAT MACHINE

The "H.L." REPETEX NEGATIVE PRINTER

The "H.L." REGISTER AND NEW MODEL PRINTING DOWN FRAMES

The WORLD-FAMOUS ARC GEAR CAMERA EQUIPMENT for Line, Tone and Colour

ETC., ETC., ETC.

You are cordially invited to visit us. Demonstrations by practical men willingly given by appointment.

HUNTER-PENROSE LTD.

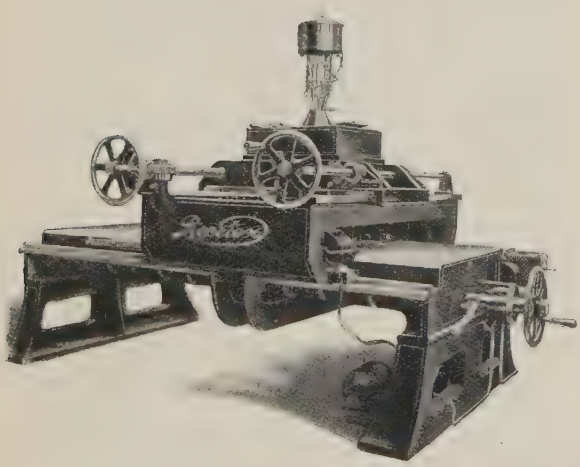
SPECIALISTS IN EQUIPMENT FOR ALL REPRODUCTION PROCESSES

109 FARRINGDON ROAD, LONDON, E.C. 1

The "H.L." REPETEX
NEGATIVE PRINTER

THE MOST ACCURATE APPARATUS YET CONSTRUCTED FOR RAPIDLY PRINTING NEGATIVES ON TO ZINC OR ALUMINIUM IN LINE, TONE OR COLOUR

The universal opinion of all who have seen it is that it represents a big advance over all other models.



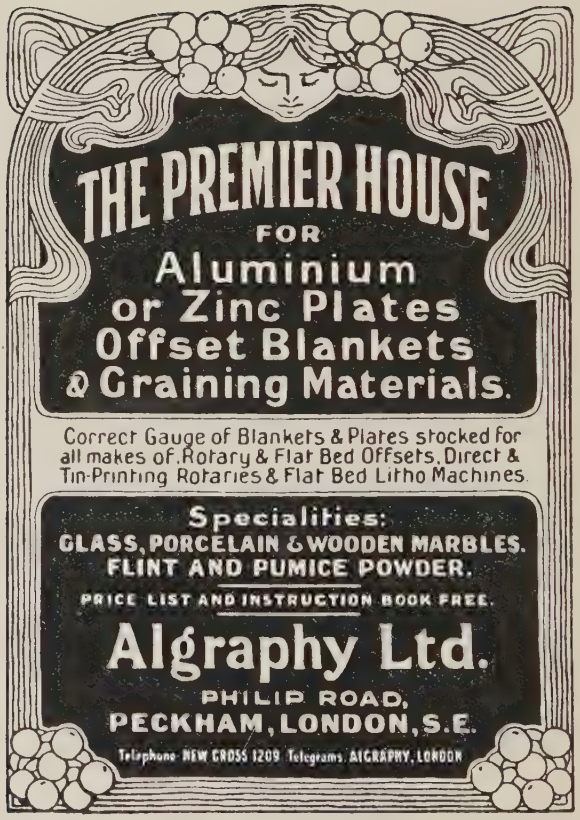
This machine is no experiment, having been used in leading litho establishments for a long time past.

On the finest and most intricate classes of work absolute hair-line register is guaranteed.

Full details gladly sent on application.

HUNTER-PENROSE LTD.

109 FARRINGDON ROAD, LONDON, E.C. 1


THE PREMIER HOUSE
FOR
Aluminium
or Zinc Plates
Offset Blankets
& Graining Materials.
Correct Gauge of Blankets & Plates stocked for all makes of Rotary & Flat Bed Offsets, Direct & Tin-Printing Rotaries & Flat Bed Litho Machines.
Specialities:
GLASS, PORCELAIN & WOODEN MARBLES.
FLINT AND PUMICE POWDER.
PRICE LIST AND INSTRUCTION BOOK FREE.
Algraphy Ltd.
PHILIP ROAD,
PECKHAM, LONDON, S.E.
Telephone NEW CROSS 1209 Telegrams ALGRAPHY, LONDON

Australian Agents :
F. T. WIMBLE & CO. LTD., Clarence Street, Sydney.

THE GREATEST POWER ON EARTH.

Printers' Ink.

We Manufacture
All Grades,
All Shades,
All Consistencies for All Processes.

Frank HORSELL & Co., Ltd.

Printing Ink, Colour and Varnish Manufacturers,

LITHO ROLLER AND PRINTING PLATE EXPERTS,
MATERIALS AND SUNDRIES,

VICTORIA ROAD, LEEDS S.

BRANCHES: London, Birmingham and Edinburgh.

OUR NAME
IN CONNECTION WITH

Litho Rollers

is synonymous with
GOOD WORKMANSHIP.

Our position is unique.
55 years' experience.
Expert Workmen.
Several of our Coverings patented.

Our Latest Invention:

Patent Plate Graining Machine

(Patent No. 240603)

Absolutely perfect working, minimum of friction, maximum of output.

Write us for particulars.

THE ONLY PLATE
seriously competing with Stone for quality of work is the

Parker Printing Plate

for Lithography.

Its acknowledged Advantages over other Plates are, briefly:

CHEAPNESS.
FINE QUALITY OF WORK PRODUCED.
SUITABILITY FOR ALL CLASSES OF WORK.
NON-OXIDISATION.
LONG RUNS WITH FEW STOPS.
SIMPLE METHOD OF MANIPULATION.

Used by the Leading Firms.

Write us for Booklet.

Lowe & Brydone Printers Ltd.

ANNOUNCE THAT

NO LICENCE IS REQUIRED

TO USE

"L-an-B"

(RODERZONE)

They will be pleased to forward full particulars on application to every Lithographic Printer interested in Metalithography. The great increase in Litho Printing from metal plates is largely due to the success attained by the use of this preparation.

It is the Finest Etching Preparation on the market.

Litho Printers are quite safe when using "L-an-B" (Roderzone) on zinc or aluminium, as it contains

NO CHROMIC ACID.

Send **2/6** for a sample ounce and full instructions. It will pay you to try it. **25/-** per lb.

The most reliable washout is "PHIRMOLD" **2/6** per lb.

New and up-to-date edition,

"METALITHOGRAPHY"

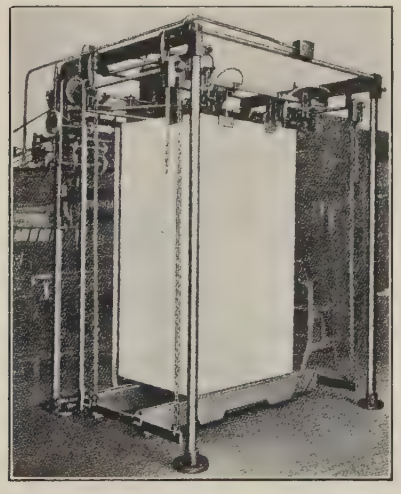
by Joseph Goodman, F.P.S. Describing the latest photographic methods of preparing metal plates for printing in a lithographic manner. Price **1/6** net.

LOWE & BRYDONE PRINTERS LTD.

VICTORIA ROAD, LONDON, N.W.10.

THE DEXTER

SUCTION PILE FEEDER



FOR ALL MAKES OF PRINTING PRESSES

Dexter Folding Machines
Sheridan Bookbinding Machines
and Labour-Aiding Machines

FOR EVERY DEPARTMENT OF THE PRINTING, BINDING AND PAPER-WORKING TRADES.

SHERIDAN MACHINERY CO. LTD.

63 HATTON GARDEN, E.C.1

Hol. 0634

GEORGE MANN

The British Offset Machinery

TIME, MONEY AND SPACE are valuable things in all Printing Houses and MANN OFFSETS ensure a saving on all three.

Turn to the illustrations on pages 179 to 187, and notice how neat and compact are all the machines. There is no wasted space—everything to hand and easily get-at-able.

Time is saved by their exceptional ease of operation and accessibility and their smooth, silent running at

HENRY STREET, GRAY'

TELEPHONE: MUSEUM 5740 (3 lines). CABLES: LITI

COMPANY, LTD.

ialists. Established 1871.

high speeds give a daily or weekly output unsurpassed by any other British Offset.

Money is saved by their economical running and their absolute reliability.

Add to these facts a constant standard of Printing Excellence, and you have the reason why the choice of so many Progressive Printers is

MANN OFFSETS

N ROAD, LONDON, W.C.1

NDON. TELEGRAMS: LITHOMAN, HOLB. LONDON.

W. R. NICHOLSON, LTD.

MANUFACTURERS OF

LITHOGRAPHIC PRINTING PLATES

(*Zinc and Aluminium*)

HEADQUARTERS FOR

Offset Printing Supplies

"NIXO" Rubber Offset Blankets

MOLESKIN—FLANNEL—FELTS—
GLASS, PORCELAIN AND WOOD
MARBLES—GRAINING SAND AND
PUMICE POWDER—TRANSFER
PAPERS—ROLLER SKINS, ETC.

Plates and Blankets Stocked in all Sizes, suitable for British, American and Continental Offset Machines.

61-63 SCRUTTON STREET, FINSBURY, LONDON, E.C. 2.

Telephone: Bishopsgate 1469.

Telegrams: "Planograph-Finsquare-London."

If it's for Litho!
Get it from Winstones

"Every Plate a Perfect Plate"

SUCH IS OUR GUARANTEE ON

"H.L."
"PERFECT"
LITHOGRAPHIC
ZINC PLATES

We maintain that you cannot obtain anywhere a purer or more finely finished LITHOGRAPHIC ZINC PLATE than the well-known "H.L." Brand.

While recognizing at all times that price counts, you must not overlook the fact that so-called cheap plates most frequently prove more expensive.

Only the best plate is economical in the long run.

If *you* are not using "H.L." LITHOGRAPHIC ZINC PLATES, please write *to-day* for PRICES AND SAMPLE.

HUNTER-PENROSE LTD.

109 FARRINGDON ROAD, LONDON, E.C. 1

IMPERIAL PROCESS PLATES

(" *New Series* ").

MANY years of research have enabled us to produce that long-wanted but evasive medium—the DRY PLATE WITH THE WET PLATE " SPARKLE." Imperial Process Plates ("New Series") give superb results for either line or half-tone work, which experts admit are indistinguishable from the finest wet-plate negatives. Imperial Process Plates are always uniform in speed and quality.

The same emulsion, coated on a thin, easily-oiled paper base, makes that ideal medium for lithographic and kindred work now familiar to the trade as

IMPERIAL "99" PAPER

and this emulsion, rendered highly orthochromatic, yields the finest document paper yet produced.

Made perfectly by

THE IMPERIAL DRY PLATE COMPANY, LTD.,

CRICKLEWOOD, LONDON, N.W.2.

Telephone: Willesden 4286.

Telegrams: " Impeople, Crickle, London."

"ZETCH"

(*free from Chromic Acid*)

A PREPARATION FOR ETCHING ZINC AND ALUMINIUM LITHO PLATES

Used by all the Leading Lithographers.
Prevents Oxidising after use.
Ensures Reliable Work.
Simplest Etch on the Market.

Supplied in Cartons at 12/6 per lb. (makes 4 gallons).

ALGRAPHY LTD., PHILIP ROAD, PECKHAM RYE, LONDON, S.E. 15

"Kodaline" for Process Work

"Kodaline" is a "Kodak" paper specially prepared for *negative* making by the process worker. It gives clean, sharp-cut lines and dense black with ordinary development. There is no need for clearing or intensification, although both can readily be carried out if desired.

"Kodaline" equals wet collodion in quality of work and is considerably cheaper

Kodak Limited, Kingsway, London, W.C.2

"If it's Waite & Saville's it's right"

YOU hear this said so often that it has become a slogan.

Any user of a

Waite Rotary Offset

will endorse it.

The perfect helical cylinder gears obviate gear marks, and their efficiency is maintained by relieving them of the heavy inking mechanism. This is driven independently direct from the driving shaft.

Absolute Register.
Perfect Inking.
Silent Running.

Will print the heaviest solid or the most delicate tint, and by far the

Easiest to Operate.

WAITE & SAVILLE, Ltd. FALCON WORKS OTLEY . . Yorks.

Install

"HARRIS" ROTARY OFFSET MACHINES

Built in the following Sizes with Automatic Feeders and guaranteed Speeds ranging from 3,500 to 5,000 impressions per hour.

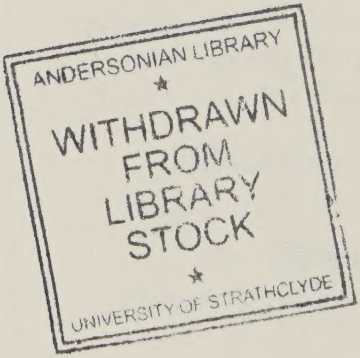
SINGLE-COLOUR SIZES :

24 *in.* × 36 *in.* *to* 44 *in.* × 64 *in.*

TWO-COLOUR SIZES :

36 *in.* × 48 *in.* *and* 44 *in.* × 64 *in.*

The
LANSTON MONOTYPE CORPORATION Ltd.
43 and 44 Fetter Lane, London, E.C. 4


ANDERSONIAN LIBRARY
WITHDRAWN
FROM
LIBRARY
STOCK
UNIVERSITY OF STRATHCLYDE

Riley Dunn & Wilson Ltd
EXPERT CONSERVATORS & BOOKBINDERS